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OUR CONTRIBUTORS

Mr. Clapp is a consulting geologist specializing in petroleum. From 1902 to 1908 he was connected with the U. S. Geological Survey. In 1914, in association with others, he was engaged in the geological investigation of northern China. Among recent papers of his are: "The Ethics of the Petroleum Geologist" (*Econ. Geology*, Vol. 12, 1917) and "A Review of Present Knowledge Regarding the Petroleum Resources of South America" (*Amer. Inst. of Mining Engineers Bull.* No. 130, 1917). He contributed the article "Along and Across the Great Wall of China" to the *Geographical Review*, April-May-June, 1920.

Mr. Bishop knows the Far East well, having spent altogether 18 years there. In 1915 and 1917 he conducted archeological exploration in China for the Museum of the University of Pennsylvania. In 1918 he was ordered to Peking as Assistant Naval Attaché. Since his return to the United States in 1920 he has been engaged in compilation of data collected in the Far East and in study at the University of California and Columbia University, and is now acting as assistant in the Anthropological Department of the latter university.

Dr. Mather is professor of geology in Denison University. His work has been largely in the field of petroleum geology. In 1919–1920 he was engaged in reconnaissance work of this nature in Bolivia and Argentina.

Dr. Kindle is paleontologist in charge of invertebrate paleontology, Geological Survey of Canada. Previously to this appointment he was associated with the Geological Survey of the United States as geologist and paleontologist. Dr. Kindle recently carried out investigations in the Mackenzie River Basin. He has published two papers on this region in the *Geographical Review*, "Arrival and Departure of Winter Conditions in the Mackenzie River Basin" (December, 1920) and "Mackenzie River Driftwood" (January, 1921). His most recent work has been done in southeastern Labrador.

Dr. De Geer is chairman of the Geographical Institute of the University of Stockholm and lecturer in Economic Geography at the Commercial High School of that city. He is the author of several physiographic papers, but he is especially known for his writings on population distribution and city geography.

Professor Musset is professor of geography at the University of Rennes. His several writings on western France include an excellent monograph on Bas-Maine (1917).

Dr. Novakovsky, who is Polish by birth, is a graduate of the Kiev Commercial Institute where he also acted as assistant professor. He is one of the founders of the Geographical Institute in that city. On four occasions (1911, 1913, 1915, and 1917) he was sent by the former Russian government to Asia and Japan for scientific work. In 1921 he received the Ph.D. degree of Yale University. Dr. Novakovsky has lately been appointed special lecturer at Clark University.

Professor Ward, of Harvard University, is one of the foremost authorities on climate in this country. The present article is the eighth in a series appearing in the *Bulletin* and *Review* of the Society on various aspects of the climatology of the United States.

Dr. Huntington is research associate in geography at Yale University. He has especially studied the question of secular changes in climate and their influence on civilization. His numerous writings on this subject include "The Pulse of Asia" (1907); "Palestine and Its Transformation" (1911); "The Climatic Factor as Illustrated in Arid America" (*Carnegie Inst. Publ. 192*); "Civilization and Climate" (1915); "World Power and Evolution" (1919).

Cont.
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THE
GEOGRAPHICAL REVIEW

VOL. XII JANUARY, 1922 NO. 1

THE HWANG HO, YELLOW RIVER

By FREDERICK G. CLAPP

From Kansu to Shantung the Hwang Ho is a dirty yellow. This color whence the river takes its name comes from the silt-like loess which it carries in suspension and which likewise gives name to the sea into which it flows. The river-borne loess is at once source of prosperity and of disaster. The alluvial plains of the Hwang Ho are of extraordinary fertility; but in its lower course the aggrading stream periodically breaks its banks, devastating the surrounding country and earning its well-known synonyms, "China's Sorrow," "The Ungovernable," and "Scourge of the Sons of Han." [1]

HISTORICAL IMPORTANCE OF THE HWANG HO

In the basin of the great river, with its vast agricultural possibilities and its difficult problems of water control, Chinese civilization acquired its distinctive character. All accounts agree that this basin was the "cradle of the Chinese race." Whatever the origin of the race—and it seems most probable that they were a steppe people from the west—we find the Chinese at the dawn of history settled on the hill-sheltered plains of Shensi, whence they spread to the wide plains of the east, of Chihli and Shantung.[2] In the fertile plains are the ancient centers of religion and culture—from Sianfu (Singanfu), historic capital of the Wei Ho valley, to Tsinanfu at the foot of the holy mountain of Shantung. Among legends concerning the Hwang Ho is one that out of the river the original Chinese dragon brought to Fu-hi (whose reign is said to have commenced at Sianfu in B. C. 2852) the scroll on which were engraved "the eight permutations," or strokes from which the Chinese alphabet has developed.

[1] L. Richard: Comprehensive Geography of the Chinese Empire, Shanghai, 1908, p. 28.

[2] For references to current theories on the subject see the next article, "The Geographical Factor in the Development of Chinese Civilization," by C. W. Bishop, p. 19. Special reference should be made to E. T. Williams: The Origins of the Chinese, *Amer. Journ. of Phys. Anthropol.*, Vol. 1, 1918, pp. 183–211.

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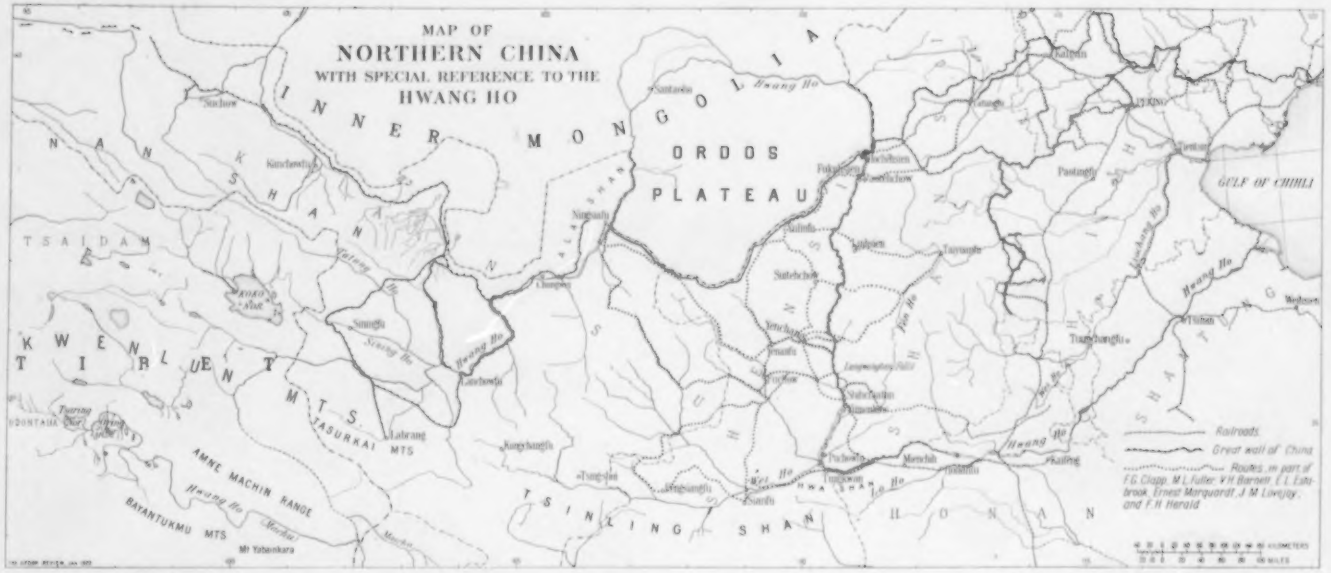

FIG. 1—Sketch map of the Hwang Ho. Approximate scale 1 : 11,000,000. The map is reduced from that of the Great Wall of China (scale 1 : 2,000,000), *Geographical Review*, Vol. 9, 1920, with additions to complete the course of the river, and with revisions of the routes followed by the author and his associates.

Source and Upper Reaches of the Hwang Ho

The great river [2] rises in east-central Tibet about 60 miles west of Tsaka Nor (lake) or Tsaring Nor, south of the Kwenlun Mountains and of the Koko Nor region. The region was visited by Przhevalski in 1884, who says that the Yellow River "is formed at a height of 13,600 feet by two streamlets, flowing from the south and west, out of the mountains scattered about the plateau, and is fed by numerous springs of the wide marshy valley (40 miles by 13⅓ miles) known by the name of Odon-tala, known to the Chinese as *Sing-su-hai*, or starry sea."[4] Rockhill crossed the Odontala a few miles west of Tsaring Nor in 1889 entering from the Ts'aidam basin by the Bordzakera pass, 15,650 feet elevation. In the valleys were many large bears, practically the only inhabitants. Rockhill tells us that every year in the seventh moon the source of the Hwang Ho was worshipped by the Chinese Emperor, who sent an official to sacrifice a white horse and seven or eight white sheep. The officials, however, are supposed usually to have pocketed their expense money and to have refrained from purchasing and making the animal sacrifice.[5] Tafel visited the region in 1906. He describes the main source of the river as lying in a depression at the western end of the Odontala about 100 kilometers west of Tsaring Nor, in latitude 35° N. and longitude 95° E., and at an elevation of 4,350 meters (14,270 feet). He credits Tsaring Nor with an elevation of 4,260 meters (13,975 feet) above sea level.[6] From the Tsaring Nor the Yellow River flows into the Khnora Nor, or Oring Nor, a few miles east. The eastern shore of this lake and a part of the upper course of the Yellow River were traversed and mapped by the Filchner expedition of 1903–1905.[7] Other tributaries of lakes Oring and Tsaring are said to bring more water into them than the stream commonly recognized as the source of the river.

The upper part of the Hwang Ho is called Soloma by the Mongols and Ma ch'u or Rma ch'u by the Tibetans, and it is also known as Alten Gol or Gold River. The old highway from Siningfu in western Kansu to Lhasa, the capital of Tibet, crosses the Hwang Ho only a few miles west of Tsaring Nor. From the lakes the river flows eastward for 200 miles and then bends northwestward, flowing in places in a broad valley where the stream itself is over 600 feet across.

In the year 1908 Vicomte d'Ollone, a major in the French army, traveled from Sungpan, in northwestern Szechwan, down the "Little Yellow River"

[2] Certain parts of the course have never been traversed; hence the length of the river can only be estimated. Richard gives 2,700 miles, the figure given by the U. S. Geological Survey (*Press Bull. 478*, October, 1921); common school geographies give a length of 2,800 miles; the writer places it at 2,900; and Herrmann (Der Hwang-ho, *Zeitschr. der Gesell. für Erdkunde zu Berlin*, 1916, p. 86) apparently at 3,075 miles, that is only slightly less than the Yangtze.

[4] Letters from Colonel Prejevalsky, *Proc. Royal Geogr. Soc.*, Vol. 7, 1885, pp. 167–172; reference on p. 170.

[5] W. W. Rockhill: The Land of the Lamas, New York, 1891, pp. 170–173.

[6] Albert Tafel: Meine Tibetreise, 2 vols., Berlin, 1914; reference in Vol. 2, p. 20 and map.

[7] Wilhelm Filchner: Wissenschaftliche Ergebnisse der Expedition Filchner nach China und Tibet, 1903–1905, 11 vols., Berlin, 1906–14. A short account of the work of the expedition, with map, is given in *Deutsche Rundschau für Geographie*, Vol. 37, 1914–15, pp. 521–526.

to where it meets the Yellow River near the apex of its great bend in eastern Tibet. That portion of the river was said not to have been previously explored. Although Ollone expressed his opinion that the source of the Hwang Ho is in the Amne Machin range of mountains, from 100 to 300 miles farther east than the ordinarily supposed source, no evidence seems to exist of the truth of this suggestion. Ollone's opinion was based on the fact the nomadic tribes living in the vicinity of the Amne Machin range call it the Anyei Machi.[8] He explains that "in their language *anyei* signifies 'ancestor', and *Machi* is their name for the Yellow River," hence, that the name of the mountain range would signify "ancestor of the Yellow River." According to Ollone "it is the universal belief that this range contains the principal springs of the river, which have hitherto been attributed to the lakes Nyoring-So and Doring-So."

The Yultao Hwang Ho, or Little Yellow River, reaches the Great Yellow River, which is rather more rapid, in the midst of a level plain; and the slower stream is repulsed so that the channel is almost checked by the detritus. Caravans composed of hundreds of yaks and fighting men with long gleaming lances come from the Tibetan desert regions every few months, crossing near the mouth of the Little Yellow River and proceeding thence to Sungpan (Songpanting) in northwestern Szechwan. They are composed largely of merchants of that place, who carry tea into the Koko Nor region and return with hides and pelts.

According to Ollone, who carried a theodolite, the tip of the great bend is about 60 miles farther east than it appears on maps published previous to 1912.[9] The Little Yellow River rises a few miles northwest of Sungpan and runs northwestward over 200 miles through a barren mountain region to its confluence with the Hwang Ho. The Tibetans call this principal tributary the Maichu and call the main river the Machu or Machi. It should be noted that Ollone does not place the mouth of the Little Yellow River on the tip of the great bend, but about halfway from there to the point where the Yellow River again bends northeast. The region of the Yultao Hwang Ho is thinly populated by the federation of Dzorgei, comprising wild tribes living by pillage as well as by cattle raising.

Occupying the great bend of the Hwang Ho and westward is the mountain mass now known as the Kwenlun, of which the Amne Machin range is the eastern end. South of this stretch of the river lie the Bayantukmu Mountains and Mt. Yabainkara.

Near the confluence of the two Yellow Rivers, hidden in a hollow of the mountains, stands the convent of Chaga Weisyong; and near the headwaters of the Tana Chu in the northern flanks of the Tasurkai Mountains is the celebrated lamasery of Labrang. The latter has hitherto been mentioned as the terminus of the southern branch of the Kansu loop of the Great Wall

[8] Vicomte d'Ollone: In Forbidden China, transl. by Bernard Miall, London, 1912, p. 256.

[9] *Op. cit.*, p. 250. In *La Géographie*, Vol. 21, 1910, p. 438, Ollone gives the position of the most easterly point of the great bend as latitude 33° 34′ N. and longitude 102° 10′ E. (99° 50′ E. of Paris).

of China, but Ollone found the Great Wall continued as a lofty rampart, still guarded by an outpost of soldiers, about 100 miles farther south, only one day's journey north of Sungpan,[10] in the borders of Szechwan.

The Hwang Ho in Kansu Province

The elevation of the Hwang Ho on the Tibet-Kansu boundary is given as 8,230 feet above the sea, and at Lanchowfu 5,100 feet.[11] About 70 miles east of the Kansu border it is crossed by the west limb of the so-called "Tibetan Loop" of the Great Wall of China.[12] It passes the city of Sünhwa a few miles farther on, and about the center of eastern Kansu it reaches Lanchowfu, at which point the "Tibetan Loop" joins the main Kansu loop of the Great Wall.

In this part of its course the Hwang receives from the west an important tributary, the Sining Ho, which, with its own tributary the Tatung Ho, rises in the Koko Nor region and enters the Hwang Ho about 40 miles above Lanchowfu. In the same region the Tao Ho enters from the south, flowing from the northern slopes of the Min Shan on the border of Tibet east of the great Tibetan loop of the Hwang.

The great city of Lanchow, the capital of Kansu Province, picturesquely surrounded by heights crowned with pagodas and built on both banks of the Yellow River, was crossed until recently by a bridge of boats over 600 feet in length, known in China as the "most beautiful bridge in the world." In 1909 it was replaced by a fine steel bridge whose construction was supervised by an American engineer, Robert Coltman 3rd. This is the only bridge over the river till that on the Peking-Hankow railroad is reached in the eastern maritime provinces. The bridge is crossed by a continuous stream of travelers, proceeding to and from the east and west along one of the greatest highways of the world (the old "silk road"). This great route connects Sianfu with the provinces of Sinkiang, western Mongolia, northern Tibet, western Siberia, and Turkestan. Along it the two-wheeled cart is the principal means of long-distance travel, but wheelbarrows are also common. Lanchowfu is the principal stopping place in Kansu for most of this traffic. The population, variously estimated at figures ranging from half a million to less than 100,000,[13] is largely Mohammedan, but one sees nearly all eastern religions represented. Ollone compares the mingling of peoples on the bridge thoroughfare with that on the bridge of the Golden Horn. The streets of Lanchowfu are narrow for the cities of northern China; but the houses are mostly well built, and the city walls and gate towers are in good repair. The chief industries are related to tobacco and fur brought

[10] Ollone, *cit.*, p. 217.

[11] Albert Herrmann: Der Hwang-ho. Versuch einer Monographie nach Filchners und Tafels Forschungen. *Zeitschr. der Gesell. für Erdkunde zu Berlin*, 1916, pp. 79–94; reference on p. 86.

[12] See the author's article "Along and Across the Great Wall of China," *Geogr. Rev.*, Vol. 9, 1920, pp. 221–249.

[13] R. S. Clark and A. de C. Sowerby (Through Shên-kan, London, 1912, p. 60) give 500,000; Tafel (*op. cit.*, Vol. 1, p. 151) compares the several estimates that have been made. He is of the opinion that the town numbers not more than 120,000 at the outside.

from the west; but gold, silver, and jade merchants and curio dealers were numerous in the days of the Empire.

The valley of this part of the river is fertile and intensively cultivated by irrigation. Water for the purpose is raised by means of wooden wheels with attached buckets placed in the current along the banks (compare Fig. 13, p. 35). The surrounding country, however, is dry and barren. The river at Lanchowfu is frozen over for one and a half months in the year.

Fifteen miles below Lanchowfu is the little village of Hsiaoshuitzu[14] perched on a rocky cliff on the south bank of Hwang. At that place the

FIG. 2—Gorge of the Hwang Ho—narrows in Sinian limestone—near Hochêhsien in northwestern Shansi. (Photograph by E. L. Estabrook.)

tortuous but swift river cuts deeply into granitic rocks and turns abruptly to pursue a general northeasterly direction.

Until Chungweihsien is reached the river flows through gorges, and its course is marked by rapids.[15] It is, however, navigated to some extent by rafts and boats, the former being the safer. Below Chungwei the Ordos is entered. In its stretch northeastward from Kansu through the Ordos the Hwang Ho flows mainly through desert, which has buried former cultivated plains and in places even the Great Wall. At Chungwei a new loop of the river has temporarily restored the fertility of the soil and supports a fairly large population. Some irrigation is done in such places, but long-buried cities exist in this region. The northern boundary of a portion of eastern Kansu follows the Hsi, Holan, or Ala Shan (mountains), which are bordered on the south for over 100 miles by the Hwang Ho. In this part of its course

[14] Clark and Sowerby, *op. cit.*, p. 59.

[15] Eric Teichman: Routes in Kan-su, *Geogr. Journ.*, Vol. 48, 1916, pp. 473–479.

the river is deflected northward by the Ordos plateau. Throughout the greater portion of its course in Tibet and Kansu the Hwang appears to traverse mainly crystalline rocks, though at Ningsiafu on the border of the Ordos the stream is not far distant from the western border of the Carboniferous basin of eastern Kansu and Shensi. The river leaves Kansu Province at an elevation of about 3,300 feet above the sea.

On the line of the Great Wall, close to the Mongolia-Kansu-Shensi border is the important city of Ningsiafu in an oasis of considerable size. At Santaoho, somewhat more than 150 miles below here, Belgian Catholic

FIG. 3—One of the many picturesque glimpses of the Hwang Ho in the stretch between Shansi and Shensi. (Photograph by E. L. Estabrook.)

missionaries have introduced irrigation, planted trees, excavated irrigation canals, and redeemed a tract from the desert, so that a substantial Christian mission which was built up years ago includes some thirty villages. The "burgomaster" of that community is as much its ruler as is the Magistrate of most Chinese municipalities.

THE HWANG HO IN MONGOLIA

About 150 miles north of Ningsiafu the river bends gradually eastward under the influence of the highlands comprising the Charanarin Ula or Lan Shan on the north. In this vicinity the Hwang has at various times had several ancient courses, which in one case differ from its present channel throughout a distance of over 180 miles, the middle point of which lies nearly 50 miles outside its present position.

The region comprised in this great bend of the Hwang Ho north of Shensi Province is known as the Ordos Desert, roughly circular and about 250

miles across. A part of the Desert of Gobi, it is one of the most barren regions of the world, although it once had a civilization whose existence is evidenced by buried cities and other instances of culture. Its sand dunes, quicksands, and barren hills are inexpressibly dreary and have been crossed by few travelers.

About 400 miles below Ningsiafu the river again bends southward, at the point where it strikes the Shansi boundary. Steamers sometimes descend the river as far as Hokow just within the boundary. Below Hokow navigation becomes difficult. In the autumn of 1914 S. H. McClure, working under

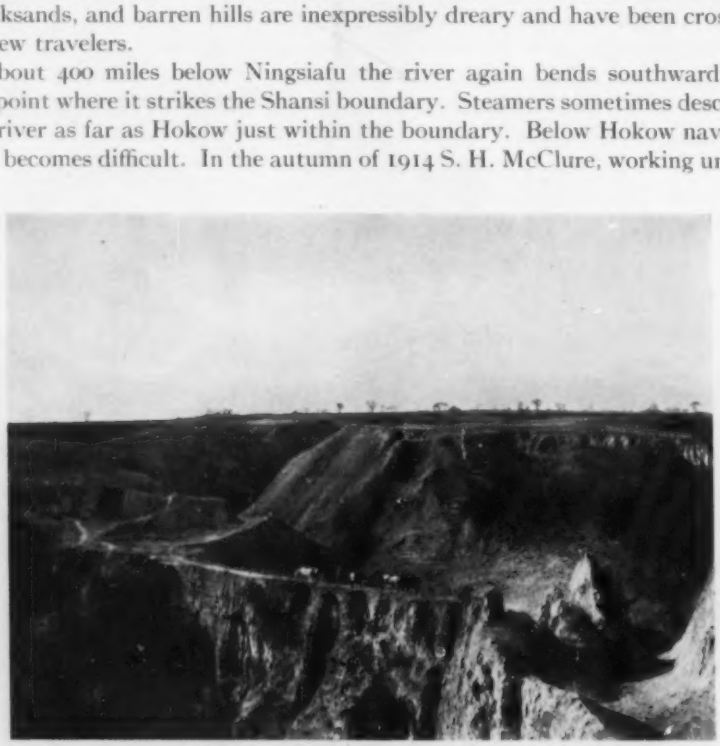

FIG. 4—A loess "bridge" near Yenchang, Shansi. Such features, which sometimes are true bridges, are common in the high plateau of Shensi. Usually they are only practicable for travel on foot or in the saddle.

the direction of the writer, made a hazardous trip by flatboat from Hokow 100 miles downstream to Hochêhsien, descending the dangerous rapids known as the "Dragon's Mouth." The river in places passes through miles of deep gorge and towering cliffs between which the waters rush and swirl.

The river crosses the Great Wall at Hochêhsien, a branch of the wall partly in ruins bordering the left bank of the river from 10 miles or more above this point to 15 or 20 miles below it. Ten miles above Hochêhsien the Hwang is intersected by a fault against the edge of Carboniferous coal-measure rocks, and the Sinian [16] (Cambro-Ordovician) rocks are thrown down to the north, forcing the river to bend abruptly west as far as Hochê-

[16] The term Sinian, introduced by Pumpelly to express a system of folds in eastern Asia, was applied by Richthofen to a limestone formation in northeastern China where these folds prevail. See J. S. Lee: An Outline of Chinese Geology, *Geol. Mag.*, Vol. 58, 1921, pp. 259–265, 324–329, 370–377, and 409–420; reference on p. 328.

hsien where it again turns south. The river appears to be about 3,000 feet above sea level, and the high rolling hills reach to about 4,300 feet. From here southward the Hwang Ho crosses sediments of Carboniferous age, though for the major part of its Shensi-Shansi course the river is not far from the contact of the Carboniferous with the hard Sinian limestone which rises in the high mountain ranges to the east.

It may be noted here that in northern Shensi, some miles west of Fukuhsien, deposits of volcanic tuff and agglomerate indicate the existence of a former vulcanism in that general section of the country. The enormous

FIG. 5—Chingshuikwan, Shensi, from the Shansi shore. Chingshuikwan lies at the foot of a typically rough loess trail one day's journey northeast of Yenchang.

"volcanic bombs" found in the agglomerate stratum suggest the former existence of a great volcano.

THE SHENSI-SHANSI PORTION OF THE RIVER

Thirty or thirty-five miles below Hochêhsien are Paotehchow, an important walled and turreted city on the Shansi bank of the river, and Fukuhsien, a similar city on the Shensi side. The party accompanying the writer and Edward L. Estabrook first visited Paotehchow, subsequently ferrying across to the other side. Both cities impress one as being much more prosperous than places visited farther east in spite of the difficulties of the trails. These are very great.

In their geology, topography, and industries the adjoining portions of Shansi and Shensi closely recall portions of Pennsylvania and West Virginia.

The hilly character of the trails, for instance, is a reminder of similar roads in West Virginia. From an altitude of 4,500 feet above the sea at the summit of Chienhungai Liang, eight miles east of Paotehchow, one descends to less than 3,000 feet at the river level, crossing a region of deep valleys on the sides of which are exposed coal-bearing Carboniferous rocks, standing out in sharp contrast from the overlying loess. The mines are operated by natives after their own primitive methods, and long lines of mules laden with great "run-of-the-mine" lumps may be seen starting to transport the coal eastwards. Here and there in the valleys stand numbers of brick and tile kilns and pottery works. The section closely resembles the deep ravines in the vicinity of Pittsburgh; one almost expects to see modern coke ovens or the chimneys of Homestead pouring forth their smoke. Nevertheless the air is clear.

The loess country of Shansi and Shensi is one of the roughest and strangest in the world.[17] In all the approaches of the writer's parties to the river or its side valleys, hundreds of feet were climbed in loess. When wet the loess is as slippery as the most argillaceous clay, so that the steep grades of the trails are then impassable. Most of the loess trails leading out of the valleys have grades of over 25 degrees. During wet weather it is impossible to reach the plateau.

With its coal mines and ferries and the pottery business Paotehchow is destined to become an ever more important place than it now is. The people are not antagonistic to strangers but have the ever-present curiosity of the Chinese concerning anything new or foreign. The existence of a small but comfortable inn enabled the writer's party to decline a cordial invitation from the Magistrate to stop in his *yamên*, and in front of the inn the populace celebrated the visit of Americans by setting off firecrackers both night and morning. The quarters proved to be the most comfortable between Peking and Yülinfu. An excellent Chinese dinner given by the civil and military officials and principal Chinese merchants proved a pleasant event.

At a point lower down on the river, at Hwanghoyeh, the Clark-Sowerby expedition crossed going west in the autumn of 1908.[18] The altitude was estimated as 2,400 feet above the sea, and 3,000 feet below the pass 20 miles distant on the highway to Linhsien in Shansi. The average height of the range between the Hwang Ho on the west and the Fên Ho on the east is 7,000 to 8,000 feet; but some crystalline peaks, like Mo-êrh Shan, rise much higher.

Below Paotehchow the next place at which the river was seen by a party under the direction of the writer was about 80 miles lower down, at Machiatun on the Shansi bank, 35 miles northwest of Linhsien. A crossing here was made by the late V. H. Barnett.

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[17] The writer has given a short account of the loess in his article "Along and Across the Great Wall of China," *Geogr. Rev.*, Vol. 9, 1920, p. 228.

[18] Clark and Sowerby, *op. cit.*, p. 14.

FIG. 6

FIG. 7

FIG. 6—The Hwang Ho looking downstream from Chingshuikwan.
FIG. 7—The Hwang Ho looking upstream from a point between Kochent'an and the falls of Lungwangchan. Old fortifications are seen on the Shansi shore.

Farther down the Hwang Ho was approached at Chingshuikwan. To reach it we crossed shaky loess or sandstone cliffs which had been undermined by water, traveled on roadways hardly two feet wide with canyons 100 feet deep on both sides and frequently having yawning pits close beside them several feet in diameter and apparently bottomless.

The similarity of this part of the Hwang Ho canyon with that of the Colorado is not mere fancy, for here the great valley abounds with mesas as does that of the Colorado, and strata of sandstone and shale are piled a thousand feet one upon another up to the loess which rises hundreds of feet higher to the plateau level, making a picture long to be remembered.

The Hwang Ho is only an eighth of a mile wide at Chingshuikwan, so that one can almost speak across it; but, when the writer's party wished to cross the ferrymen steadfastly refused for three days to enter the boats, declaring the current too rough for safety. We could now appreciate the reply of the Magistrate of Yenchanghsien in Shensi who, a few days previously, on being asked what could be done to help the city, had responded, "Build a bridge over the Hwang Ho." The single available ferryboat was small and leaky, accommodating only thirteen men and three animals by crowding; and with this load the party finally succeeded in reaching the Shansi shore.

The climb from the river level was up 1,700 feet over rock and loess hills bounded by deep canyons, across which distant views of mountain and valley were at times secured. Finally, 3,600 feet above the stream, the party stopped for the night in a cave village underlying a wheat and vegetable field on the loess plateau. Within a few score of miles this portion of the Hwang Ho has been crossed by several of the writer's parties, including those of John M. Lovejoy and Edward L. Estabrook. Crossings here were also made by Myron L. Fuller, associated with the writer in the explorations in China.

The vicinity of Shihchiat'an, still farther down the river, is quite different in aspect from the country around Chingshuikwan. Instead of living in caves the people have substantial houses, and the narrow stretches of flood plain contain frequent small farms. A short distance below Shihchiat'an are coal mines which give rise to various industries. The river is navigable from near there to a point in the province of Honan, and numerous boats can be seen floating down or being "tracked" upstream.

A highway along the Shansi side of the river near Shihchiat'an was built at the time of the Taiping Rebellion and was then probably a good road; but it is now in such bad repair as to be barely passable for horses. Along six miles or more of it, paralleling the Hwang Ho, the ruins of a massive stone wall built at that time can still be seen. It is six to eight feet high and two feet or more in thickness, with numerous portholes, and must have proved an effectual barrier to attacks from the river or from the Shensi shore.

Land and Water Transportation

The entire portion of the Hwang Ho between Shensi and Shansi is inaccessible by cart or by any form of vehicular travel, and the mountain trails are perhaps the roughest in the world. A cart road from the north touches the river at Potow in Mongolia and another at Hokow, about 100 miles apart on the northeastern portion of the Ordos loop. The former road extends northeast through Mongolia, the latter eastward in Shansi Province to Fengchen and Tatungfu. Both highways make connection with river shipment.

Traveling on the middle stretch of the river is said to average three to four miles an hour. At Laolungkow, in the stretch between Hokow and Paotehchow, is a very dangerous rapid caused by a single large rock in the river. Although from 500 to 1,000 boats descend this rapid every year, the loss is said to be less than one per cent, or about three or four boats a year. The river is open to navigation at Hokow about the first of April, is generally closed during July and August on account of heavy rains, and is again passable in September, October, and November.

In a few places where the water is low the cargo must be unloaded and reloaded. The boats seldom if ever return north but are sold at their southern destination. Some of the larger boats are said to carry as much as 30,000 pounds on a trip. The boats are commonly guided through the dangerous spots by experienced local pilots, and the Chinese boatmen are accustomed to burn incense when passing through the "Dragon's Mouth."

The Great Falls

A few miles above Shihchiat'an on the Shensi shore is Kochent'an in the district of Yichuan. This part of the Yellow River, visited by the writer in March, 1914, is one of its wildest sections. The gorge consists of a deep canyon, and in order to reach the river level the party was obliged to descend 1,500 feet from the loess plateau. In one place, on a tributary of the Hwang Ho, is a rock cliff over 100 feet in height over which a cascade plunges in the rainy season, and for miles the river is walled by much higher cliffs.

The "ferry" on which the river is crossed is situated directly below a constricted portion, where the waters are concentrated and plunge madly over some dangerous rapids. Although stories had been heard of the "rapids" at Lungwangchan, four miles above this ferry, no one present was prepared for the magnificent cataract found there. Strange to say, it is scarcely mentioned in Chinese books available to the interpreters. It was, however, visited by Tafel in 1905 and has been described by him.[19] At a distance of many miles the clouds of spray resembled white smoke rising from a spot in the river valley. To this finally the military escort pointed and cried "Lungwangchan." At a distance of a quarter of a mile, moisture begins to blow in one's face, rendering photography difficult.

[19] Tafel, *op. cit.*, Vol. 1, pp. 61–62 and Pls. 17, 18, and 19.

The river is swift at Kochent'an and more so throughout the four miles upstream between that village and Lungwangchan, where the entire river, narrowing from a breadth of perhaps 1,000 feet, plunges into a deep gorge scarcely over 100 feet across, with a roar that rivals Niagara. The vertical drop is little over 50 feet at any one place in the river bed, but the stream descends 200 feet within five miles. As the entire volume of the Hwang Ho pours over the falls, it makes up for any lack of height.

On witnessing the falls one is at first inclined to discredit the story that boats descend the Hwang Ho from Mongolia to Honan. While standing on the brink of the canyon a mile or more below the falls, however, the writer heard a wild yelling in unison from across the valley, and over the sandstone terrace came a line of forty to fifty men, moving slowly southward as if with difficulty. Behind them, at the end of a stout cable, was being dragged a boat with its load of freight. Later other groups of men were seen dragging similar boats. Thus the inhabitants of Lungwangchan derive their living.

Between Lungwangchan and Yumênkow farther down stream are two other rapids, in which boats are sometimes lost. One is at Taoerwo, 20 miles south of the same place. Below Yumenkow the river is easily navigable to Sanmen, 17 miles northwest of Mienchih in Honan, where a great rock partially obstructs the river. The currents are said to flow towards this rock from three directions, and on it appear Chinese characters signifying "Come to me," or "Sail in my direction." By this scheme the navigator is induced to head his boat in the direction of the rock, and then the current carries him safely round it. If, however, the boatman expends his energy in trying to sail round the rock, it is said he will certainly strike it and be destroyed. Opposite Mienchih is a port named Mengchienhsien connecting it by a good cart road.

The principal tributaries of the Hwang Ho in its Shansi-Shensi stretch are the Fên Ho from the east and the Wei Ho from the west, the former being estimated as 500 miles in length and the latter at least 400 miles. The Wei Ho heads only a few miles from the source of the Tao Ho, a large tributary of the Hwang Ho south of Lanchowfu. Several other tributaries on the Shensi side are over 100 miles long.

A few legends have come to us of the early history of Shensi, which are of interest concerning the Hwang. For instance in B. C. 2297 the "prosperity of the nation," one book states,[26] was disturbed by a "thirteen-years flood." Some think that this was the Biblical flood, but accounts indicate that it was of local character. It seems to have covered the entire valley of the Hwang Ho and part of that of the Wei. Emperor Yau ordered various officials to subdue the waters, for failing to do which they were executed. However, a man of the name of Yu, who afterwards became "Yu the Great," tried for eight years to accomplish the task and finally succeeded in carrying off the water by deepening the channels. He is said to have evolved his scheme

[26] Li Ung Bing: Outlines of Chinese History, Shanghai, 1914, p. 6.

of drainage by studying the marks on a turtle's back. So the Chinese have a saying, which has come down to the present day, that "we should have been fish but for Yu."

Incidents on Route

Northern Shensi is scantily settled, and in the Ordos Desert few houses were seen, while Messrs. Fuller and Barnett who visited northwestern Shensi found they could travel all day without seeing a house. Generally, however, small villages exist every few miles, with such names as "Sanchia" (three families), "Shihlipu" (ten li shop), "Pachiats'un" (eight family

Fig. 8—Lungwangchan, the "Great Falls of the Hwang Ho," in the lower portion of the Shensi-Shansi course of the river. The falls are impressive because of the volume of water carried and the great constriction of the river bed.

village), and other equally attractive designations. Most of these places are merely cave villages—unimpressive and sometimes most forbidding to the weary traveler who is looking for a good stopping place. Yet they are dry and comfortable inside, and an entire caravan manages to be accommodated even at places like "Sanchia," "Fanti," or "Tuenchiao."

The police of Chinese cities are of many contrasts as to appearance and efficiency. Some are dressed in clean, new uniforms, carry effective rifles, and would be recognized at once as members of an efficient police force, while others wear ragged clothing and have guns which appear to be half a century old. The Magistrates, or chief governing officials, vie with each other in efforts to provide proper protection to a traveler, every Magistrate furnishing at least as large an escort as the preceding one on the route

traveled and so properly passing on the expedition to the next *hsien* or district city. On the journey from Fukuhsien west to Yülinfu, the prevalent custom of furnishing large escorts resulted in great enthusiasm along the route, so that before reaching Yülinfu the travelers were being greeted daily by music and receptions, all of which is evidence of recent lack of travel from eastern China in this distant region.

On the highway running east and west through Sianfu restaurants and native "quick lunch" rooms are abundant. A sample dinner en route may be mentioned. Among the delicacies served were *chi-tz'erh*, *chao* (eggs, scrambled), *wan-tze* (meat balls), *yo pien* (chopped pork), *chi pien* (chopped chicken), *shon lui pai tsai* (Chinese cabbage with vinegar), *lao bing* (griddle cakes), *fan* (rice), and *cha* (tea). The total cost to geologist and interpreter was 786 cash, or about 25 cents in American money, and enough food was left over to furnish the waiter with a meal for himself.

The River at Tungkwanting

At the great bend of the Hwang, a few miles below the mouth of the Wei Ho, is situated the city of Tungkwan. The valley begins to narrow here, and the city walls occupy the entire space between river and hills, thereby exercising full military control over the main highway from Honan Province along which all traffic must pass to approach Sianfu, the capital of Shensi. Tungkwan lies in Shensi but so close to the borders of Shansi and Honan that it may be said to constitute the key to three provinces. Its great stone citadel has only one approach, and it is high on the hills and well protected, while the business section lies below.

For thousands of years the battlements of Tungkwan have guarded the road to Shensi, and it is one of the few places that Jenghis Khan could never storm. In his first campaign for the conquest of China that great general sent an army to take Kaifêngfu. Reaching the river opposite Tungkwan, the army decided to avoid the place and started on a detour through the mountains of southern Shensi, in which it encountered such great hardships that it was defeated and driven back across the Hwang Ho into Shansi province to the north.

At Tungkwan is a ferry which is well traveled by the natives, being one of the great ferries of China. It is one in which sails are sometimes used instead of oars, although poles are also of value in crossing during low-water stages.

At three days' journey east of Tungkwan was seen what is reported to be the "oldest tree in China," not living but encased in a brick wall. There appears good evidence that it is as old as the beginning of the Chou Dynasty, about 3,000 years ago. The tree appears to be a cypress and is a dead trunk 40 feet in height. The base is encased in a mortared brick wall, surrounded by tablets, several of which are so ancient as to be illegible. One bears the inscription "Ancient Kan-tang," another says "Kindness of Chou Kung."

The story is that a man of that name came from the West some 3,000 years ago and stopped under this tree to preach the "doctrines of civilization." He was so kind that the inhabitants ever afterwards kept the tree intact in his memory, and the duty of its protection was passed down from generation to generation.

Origin of the Shensi-Ordos Loop

Certain fundamental factors lead us to suppose the Hwang Ho has not always flowed as it does now. Leaving out of account historical floods as being too recent to have permitted the later development of any great valley, there are certain evidences that the portion of the Hwang Ho between Shansi and Shensi dates only from Quaternary time. Coming from the sizable valley with moderate gradient which extends from Lanchowfu and Hokow, the river restricts itself for 550 miles as far as Tungkwan between valley walls less than a mile apart rising semi-vertically in rock and overlying steep loess slopes to 1,000 or 1,500 feet above the river, quite different from the topography in other parts of the river's course. Although near Hochê-hsien the river passes through Sinian limestone for some miles, the rest of its southward course is excavated canyon-like in rock of Carboniferous age. This valley does not appear older than many Pleistocene or late Pliocene valleys in America and Europe. Moreover, there are, at Lungwangchan and several other points, rapids and falls entirely incommensurate in age with the Mongolian section of the river. It seems clear that the Shensi-Shansi portion of the river is younger geologically.[21] The fault at the base of the Hwa Shan range south of Tungkwan appears to be a continuation of the great Wei Ho fault. The Wei Ho valley, trending west of Tungkwan in direct continuation of the Honan course of the Hwang Ho, has a breadth of over 50 miles, a flat floor, a navigable river, and a great population. This valley heads only some 50 miles south of Lanchowfu—a fact which suggests that it may once have served as a basin for the Hwang Ho itself. In order to obtain a correct idea of the geography of this great river system, however, and of the causes of changes in its course, one would be obliged to examine the divides back from the source of the Wei.

Another region that deserves study from a similar angle is that east of Potow on the Ordos loop. If ancient valleys should be found there they would shed light on the problem. We can hardly doubt that the present Hwang River is a composite one; but further study is necessary to give definite answers to all of the questions that may be raised.

Lowland Portion of the Hwang

The lowland portion of the river may be considered to be that part east of the pass of Tungkwan, where it deviates from its previous southward

[21] On interpretation of youthful character of the Hwang Ho in its Shensi-Shansi course see "Research in China," 3 vols. and atlas, *Carnegie Instn. Publ. No. 54*; reference in Vol. 1, Part I, pp. 234–236. See also J. S. Lee, article cited in footnote 16, pp. 419–420.

course and flows nearly east to a point about 25 miles below Kaifêngfu, where it bends northeast towards the Gulf of Chihli.

Near Hwaikingfu the river passes out of its gorges and reaches the great plain of Honan and Chihli, on which it is locally navigable. In the vicinity of Takouchên the writer traveled over many miles of rich agricultural country, mainly planted with winter wheat, dotted with long lines of prosperous villages. There are also miles of great bamboo thickets, in which the trees tower high above the traveler and in the vicinity of which the chief industry is the manufacture of bamboo goods. Adjoining this great plain the rough limestone mountains of Shansi rise abruptly 2,500 feet in height, and the main road over them is paved for miles with great blocks of limestone. Fine views of the Hwang Ho can be gained from the summits.

Where the Peking-Hankow Railroad crosses the Hwang Ho the river consists of a channel or series of channels aggregating one or two miles in breadth. The water is shallow, and the channels are continually shifting. This part of the river, according to unpublished notes of Myron L. Fuller, is navigable to small boats drawing a foot or a foot and a half of water and carrying perhaps three tons of freight. The clearance at the railroad bridge runs from 10 feet at low water to less than half that at high water.

Changes in the River's Lower Course

Crossing great flood plains in its lower stretches the Hwang Ho has frequently changed its course in past ages. It has flowed alternately north and south of the mountains in Shantung Province, reaching the sea at points as much as 250 miles apart in an air line.[22] Its last important change was in 1851 previous to which time it left the present channel at the sharp bend east of Kaifêngfu, flowed southeastward through northern Honan and Kiangsu, and reached the sea only 130 miles from the mouth of the Yangtze Kiang. The Grand Canal followed the course of the Hwang Ho from Sutsien to Hwaianfu, a distance of about 60 miles. In the year 1851 the dikes gave way east of Kaifêngfu, and for two years the course varied considerably; but finally the Hwang embedded itself in the Tsi Ho, which had previously been of little importance. Another flood, which occurred in 1877, inundated an immense region and caused the death of millions of people and in 1898 was still another great flood. (See insert map, Fig. 1, p. 21.)

It is in the lower portion of the river that floods are now frequent and most dreaded. The flood phenomena consist in the bringing down of great quantities of mud from higher regions and the continual raising of the river bed which now stands many feet above the surrounding country. For instance where the Hwang crosses the Grand Canal in Shantung Province the river is said to be 16 feet above the canal level. On account of frequent floods no important city is built on the river banks in its lower course.

[22] See the maps, Fls. 4 and 5, in Raphael Fumpelly: Geological Researches in China, Mongolia, and Japan, *Smithsonian Contributions to Knowledge, No. 202*, Vol. 15, Art. 4, Washington, D. C., 1866; and Jakob Menauer: Die Laufänderungen des Gelben Flusses in historischer Zeit, Nuremberg, 1912.

THE GEOGRAPHICAL FACTOR IN THE DEVELOPMENT OF CHINESE CIVILIZATION

By Carl Whiting Bishop
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The outstanding difficulty in the way of any real settlement of the Far Eastern Question is undoubtedly the lack of a spirit of nationalism on the part of the Chinese people. But for this lack, indeed, there could hardly be any Far Eastern Question at all. The problems now clamoring for solution in southeastern Asia have arisen just because China is thus disunited and decentralized and therefore incapable of developing her own resources and determining her own policies without fear of foreign interference. If, as is unfortunately true, the control of her destinies is no longer in her own hands, it is because neither the staid and conservative North nor the alert and progressive South has been able to secure the unreserved allegiance of her entire population.

The Disunity of North and South

The spokesmen of the two sections declare, no doubt sincerely, that the point at issue is one of Constitutional interpretation; let that be settled, they tell us, and all will be well. Others, largely foreign observers these, would have us believe that the inability of Peking and Canton to discover any mutually acceptable basis for a real and permanent union is due to the different degree in which modern Occidental civilization has penetrated the two sections of the country. The South, say they, has been exposed for a longer period than the North to the influence of Western ideas. Both these explanations are doubtless true—in a measure. But that measure is not a large one.

There have been periods when China was great in the finest sense of that much misused word; when she was revered as a protector and teacher by her neighbors and respected as an equal, if not indeed as in some sort a superior, by the peoples of the West with whom she came in contact. But such periods have invariably been those when she was under the sway of a powerful dynasty able to compel the allegiance of all sections of the country. The moment the Imperial power has ebbed, ancient political and cultural and even ethnic antagonisms have emerged to view; latent tendencies toward separatism have become active; and local governments, each usually claiming *de jure* control over the whole people, have set themselves up in various sections of the country. The four hundred years of anarchy and general disruption which followed the downfall of the great House of Han, early in the third century of the Christian era, and that briefer interval.

during the tenth, known as the period of the Five Short Dynasties, offer us repeated examples of the same tendency that is operating before our eyes. And invariably the main lines of social and political and economic cleavage have run east and west, save in a few partial instances for which local and temporary conditions have been responsible.

In view of the persistence of this phenomenon despite the very real homogeneity of Chinese civilization for several centuries past, it seems clear that there must be some fundamental cause which has been operating for ages and whose unfailing tendency has been to divide the country into northern and southern sections the moment that the central authority, whether feudal monarchy or bureaucratic empire or constitutional republic, loses its grip. Such a cause, so constant in its operation and so unvarying in its effects, could scarcely be other than a physical one.

There can be little doubt, indeed, that this cultural and at times political division of China into a north and a south has been due primarily and fundamentally to the way in which the introduction and diffusion of civilizing influences from the earliest prehistoric times downward have been determined by her rivers.

Of these there are four principal groups. In the north is that including the lower Hwang Ho[1] and a few minor streams occupying what is generally known as the North China plain. South of this is the Yangtze system, separated from the preceding by that Tsingling range of mountains which with its lower eastward extension has always formed the real boundary between northern and southern China.[2] Along the coast, below the mouth of the Yangtze, the third group is composed of numerous streams, large and small, forming independent systems of their own. Lastly on the extreme west the Salween and the Mekong, though scarcely Chinese rivers in any true sense at all, still flow through Chinese territory for a certain portion of their course.

The Dawn of Civilization in China

It was in the valley of the Hwang Ho that civilization first made its appearance, some time, according to the best evidence available, between 3000 and 2500 B. C.[3] It was essentially of a Bronze Age type, not pastoral and nomadic but settled and agricultural,[4] with its fundamental features derived from the same common source with those of the great historic

[1] Save where usage has rendered other forms more familiar to the English reader, the transliteration of Chinese names in this paper follows Giles's dictionary.

[2] See regarding this function of the Tsingling range, L. Richard's Comprehensive Geography of the Chinese Empire and Dependencies, Shanghai, 1908, p. 42; Bailey Willis, *Bull. Amer. Geogr. Soc.*, Vol. 38, 1906, pp. 413 and 423.

[3] Dr. E. T. Williams has ably summed up the evidence for this in his paper, "The Origins of the Chinese," *Amer. Journ. of Phys. Anthropol.*, Vol. 1, 1918, pp. 183–211.

[4] Dr. James Legge (Shu King, "Chinese Classics," p. 191) says "The Chinese could never have been a tribe of shepherds." Shên-nung, the patron divinity of agriculture (Rev. John Ross: The Origin of the Chinese People, Edinburgh and London, 1916, p. 5) and the subject of some very early myths, is represented with the head of an ox (Henri Doré: Recherches sur les superstitions en Chine, Shanghai, 1911, Vol. 10, p. 717) and most probably stands for an original ox or bull god of fertility, so common among agricultural peoples throughout the Eurasiatic culture area. The fact that Shên-nung is represented as having been sired by a dragon, the fertilizing agent *par excellence* in both ancient and modern China, suggests this also.

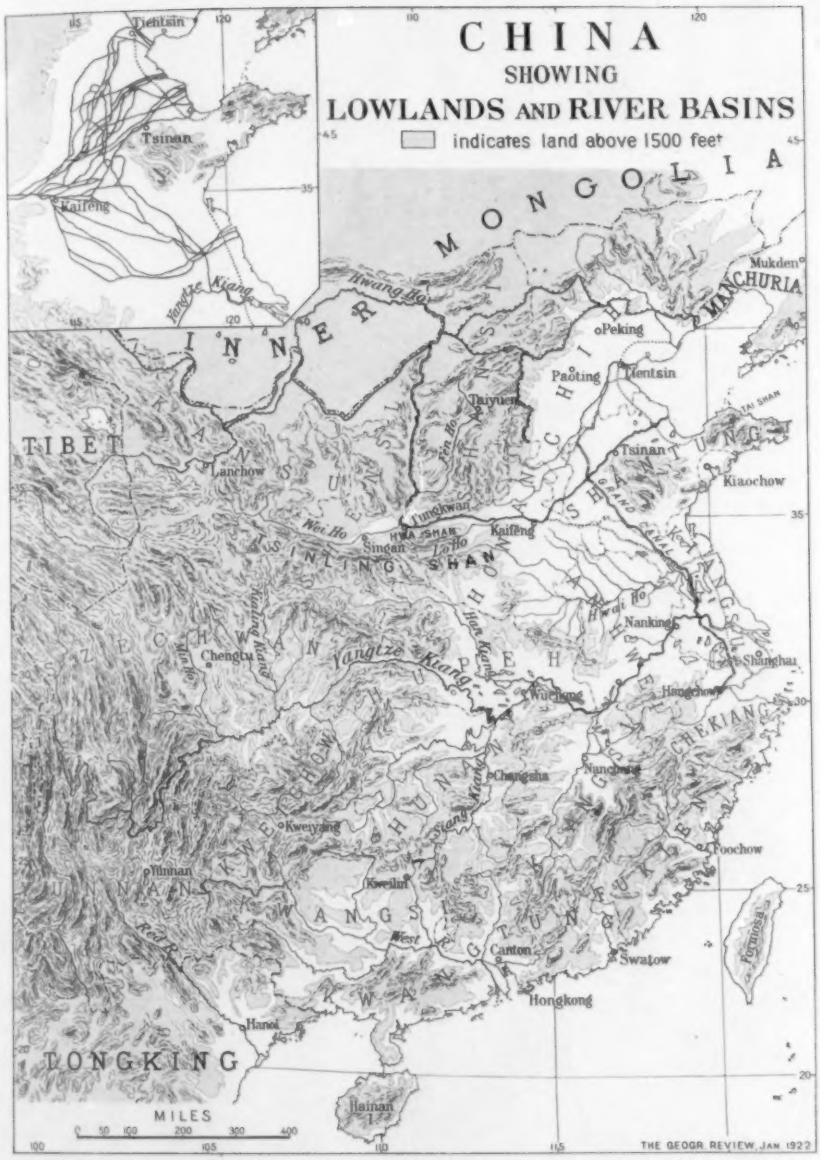


FIG. 1—Map of China showing lowlands and river basins. Note especially the Tsingling Range (part of the Hwang Ho-Yangtze divide) which with its lower eastward extension has always formed the real boundary between northern and southern China. (Scale of map 1 : 20,000,000.) Inset map showing changes in the lower course of the Hwang Ho and the seaward growth of the shoreline since the earliest historic times.

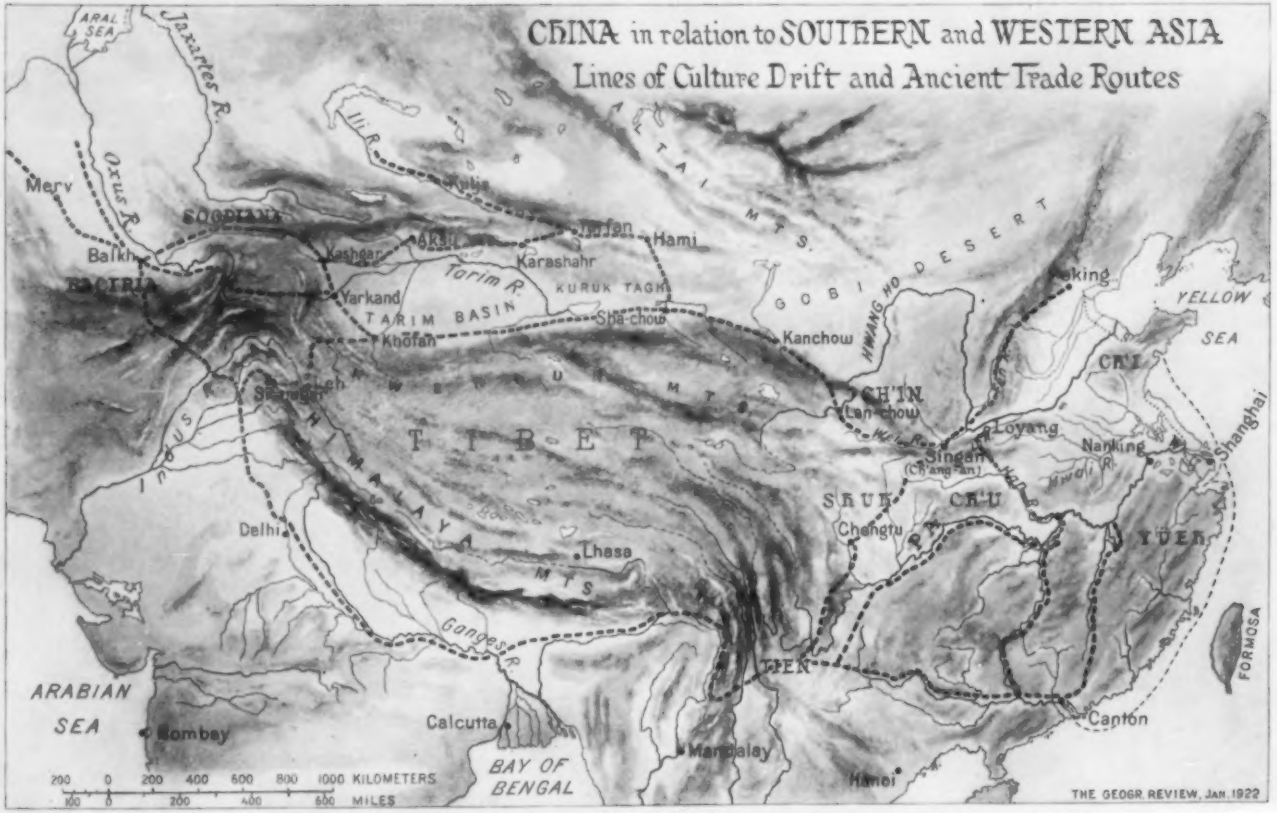


FIG. 2—Map showing the main lines along which cultural influences from southern and western Asia have penetrated into China. Old trade routes also largely followed these lines. The location of the chief seats of the ancient Chinese states is shown, the names, as other ancient names, being printed in antique lettering.

empires of the Occident.[5] The economic systems of the three ancient civilizations, Sumero-Babylonian, Indo-Iranian, and Chinese, founded alike on agriculture and cattle breeding, show much identity in detail, and there appears to be little doubt that China was indirectly in contact with western civilization from the remotest ages.[6] Von Richthofen, who considers that the Chinese had learned agriculture in the oases of the southern part of the Tarim basin, says, truly, that they were never an absolutely isolated people.[7] Specifically this earliest-known Chinese civilization appears to be related, in some way not yet clearly made out, to the prehistoric culture of southern and southwestern Siberia—the so-called "Scythic" area.[8]

Direction and Character of Cultural Spread

The Yangtze River only comes under historic notice nearly two thousand years later, early in the first millennium before the Christian era. The influences operating to bring about the growth of civilization here fall into two groups. The first and, in the long run, most potent set worked gradually southward from the valley of the Hwang Ho and hence are ultimately derivable from Central Asiatic sources. But it is becoming increasingly apparent that from prehistoric times there has been a very real and important culture drift setting from the Ganges valley through Upper Burma and so across to the upper waters of the Yangtze, whose course it has followed eastward toward the sea.[9] It is a course by which culture influences in the shape of British trade goods are still entering China, as Ainscough points out in his "Notes from a Frontier" (Shanghai, 1915).

The southeastern coast lands, shut off from the great interior basin by mountains once clad with dense subtropical forests, were civilized late, partly from the Hwang Ho and partly from the Yangtze areas. The process for the northern end of the territory was well under way by about 500 B. C., but farther south, in what are now Fukien, Kwangtung, Kwangsi, and Tongking, it hardly commenced until three or four centuries later. Part of this region, indeed, comprised in the modern province of Fukien, through

[5] Berthold Laufer: Some Fundamental Ideas of Chinese Culture, *Journ. of Race Devel.*, Vol. 5, 1914–1915, pp. 160–174.

[6] This is recognized by even so conservative a scholar as the Rev. Ernst Faber (*The Chinese Recorder*, Vol. 27, 1896, p. 548). Prof. Wm. Ridgeway (The Origin of Metallic Currency and Weight Standards, Cambridge, 1892) says that there is little doubt of a complete trade connection from extreme western Europe to China from the most remote times.

[7] Ferdinand Freiherr von Richthofen: China: Ergebnisse eigener Reisen und darauf gegründeter Studien, Berlin, 1877, Vol. 1, p. 48, footnote.

[8] On this question see P. Reinecke: Ueber einige Beziehungen der Alterthümer China's zu denen des skythisch-sibirischen Völkerkreises, *Zeitschr. für Ethnologie*, Vol. 29, 1897, pp. 141–163; also A. de Mortillet: L'Age du Bronze en Chine, *Rev. Anthropol.*, Vol. 23, 1913, pp. 397–415; Sir C. Hercules Read: Siberian Bronzes and Chinese Jade, *Man*, Vol. 17, 1917, pp. 1-4.

[9] Regarding the route followed by this line of culture penetration see Sir A. P. Phayre: History of Burma, London, 1884, pp. 4 *et seq.* and 15; L. W. Shakespear: History of Upper Assam, Upper Burmah, and North-Eastern Frontier, London, 1914, p. 8; G. E. Gerini: Researches on Ptolemy's Geography of Eastern Asia (Further India and Indo-Malay Archipelago), Asiatic Soc. Monographs, No. 1, London, 1909, pp. 28, 60 *et seq.*, 122, 124, 285, and 660, footnote 2; and Émile Rocher: La province chinoise du Yün-nan, 2 vols., Paris, 1879–1880; reference in Vol. 2, p. 264 *et seq.*

FIG. 2.—Map showing the main lines along which cultural influences from southern and western Asia have penetrated into China. Old trade routes also largely followed these lines. The location of the chief seats of the ancient Chinese states is shown, the names, as other ancient names, being printed in antique lettering.

FIG. 3

FIG. 4

FIG. 5

FIG. 3—Three of a series of beacon towers in northern Shansi near the line of the Great Wall, to give warning by fire or smoke signals of the approach of Tatar invaders. Now displaced by a line of telegraph seen to the left. This and the following photographs were taken by the author for the University Museum, Philadelphia.

FIG. 4—Winter scene in northern Shansi village; little snow; but weather intensely cold, and people mainly hibernating; fuel on roofs. Tatar influence is strong in northern Shansi; see, e.g., mounted man in picture.

FIG. 5—This memorial gateway (pai-lou) was erected about 1795, near where the Wei flows into the Yellow River; owing to deforestation of the hills near the road, it has been buried not less than 12 or 14 feet deep in a little over a century.

FIG. 6

FIG. 7

FIG. 8

FIG. 6—A portion of the north China plain, showing its monotony broken only by grave mounds, clumps of trees spared for economic value or religious reasons, and mud-walled villages. In ancient times it was customary to run furrows parallel with the frontier to hinder the war chariots of invaders.

FIG. 7—Mountains of northern Shansi, near the line of the Great Wall, showing deforestation. Records show that these mountains were once clad with magnificent deciduous forests.

FIG. 8—Torrent bed in northern Shansi, showing how deforestation has ruined valuable river bottoms by allowing gravel and boulders to be washed down over them.

just this lack of water communication with the interior, was not permanently incorporated within the Chinese Empire until so late as 939 A. D.

Owing to peculiarities of terrain in the western region, the culture spread there has been not along but athwart the principal rivers, which have been obstacles rather than aids to its diffusion. The region owes its importance to the fact that here the Yangtze valley approaches most nearly to the Burmese area, thus providing an avenue for the infiltration into Central China of those Indian influences just mentioned. Burma and Yünnan form a geographical unit that at times has also been a political unit.[10]

The most westerly point to which the origins of Chinese civilization can as yet be traced with assurance is on the upper waters of the Wei. This river drains eastern Kansu and central Shensi, falling finally into the Hwang Ho not far from the point where the latter makes its great bend eastward. Many of the earliest myths of the Chinese people are localized in its valley; and, what is more, these same myths are just those which preserve most definitely features connecting them with the folklore of western Asia and eastern Europe. Among these is the belief in beings with serpent bodies and human heads. The mythical Chinese civilizer, Fu-hi, a creature of this description, is said to have been born near the sources of the Wei, in Kansu; and the legends about him are localized mainly in the northwestern provinces of Shansi, Shensi, and Kansu.[11] The introduction of metal is ascribed to him[12] rather significantly, in the first place on account of this very connection of his with the west, and, secondly, because a similar mythological concept of a human-headed serpent also appears in that same Scythic area to which China appears to have been culturally related. Another parallel to a well-known western belief is the legend of the supernatural "great bull of the River Fêng,"[13] and there are accounts of white horses, especially white chariot horses, which suggest Occidental contacts.[14]

It was here in the basin of the Wei that the old Bronze Age civilization of China received its definite and specialized form. And apparently here it remained for a long period before it pushed on still farther east, into the great North China plain, then occupied by Neolithic barbarians who lived mainly by hunting and fishing, eked out with a primitive horticulture carried on by the womenfolk with the aid of great stone hoes precisely like those employed by some tribes of our own American Indians.

When, some time after 3000 B. C., this invasion took place, it was not, it would seem, as a concerted movement, undertaken upon a large scale all at once. What really occurred was probably a sort of culture penetration carried on slowly by traders, refugees, captives, stragglers, and, possibly,

[10] J. Klaproth: Tableaux historiques de l'Asie, Paris, 1826, p. 128; R. F. Johnston: From Peking to Mandalay, London, 1908, p. 287; and W. W. Cochrane: The Shans, Rangoon, 1915, p. 49.

[11] Édouard Chavannes: Les mémoires historiques de Se-ma Ts'ien, 5 vols., Paris, 1895–1905; reference in Vol. 1, p. 5, footnotes 2, 4, 5.

[12] Doré, *op. cit.*, Vol. 10, p. 716.

[13] Chavannes, *op. cit.*, Vol. 2, p. 18 and footnote 2.

[14] Legge, Shu King, "Chinese Classics," Part IV, Bk. 1.

small bodies of actual invaders. In the early legends [15] a prominent part is played by Hwang Ti and may indicate, as pointed out by E. T. Williams, that he was really the leader of a band of immigrants. His name, or rather title, is usually translated "Yellow Emperor," though the correctness of this has been questioned. Whatever its meaning, it may well have been the title borne by a succession of sacerdotal rulers: "Ti" connotes divinity, and might suitably be applied to a god king of the type widely spread among primitive agricultural peoples. At all events it is clear, as Dr. Williams says, that this cycle of legends is referable to extreme northwestern regions and not at all to the lower valley of the Hwang Ho, the later "Middle Kingdom."

Small City States Ancestors of Modern Townships

The result was the establishment, not of a single centralized "empire," but of a vast number of small city states, the ancestors of the modern *hsien* or townships, each under the control of a ruling clan with a patriarchal organization and a culture not very different from that of the earliest Babylonia that we know historically. The simple, almost parochial, character of the social organization depicted in the old Chinese myths proves that the latter were at first told of petty communities. Furthermore, the legends say that Hwang Ti delimited 10,000 fiefs and built a city in each. This seems undoubtedly a folk recollection of a period of small city states.

In some cases these *hsien* actually retain to this day the same names that they bore as *kuo*, or independent states, 3,000 years ago. Their numbers are given as 10,000 under the Hsia Dynasty (said to have ruled 2205–1766 B. C., but here we are still in the legendary period); as 3,000 under the Shangs (1766–1122 B. C.); and as 1,800 at the beginning of the Chou period (1122 B. C.).[16] This progressive reduction in the number of the fiefs was of course accompanied by a corresponding increase in size; but even so, the 1,800 said to have been in existence at the close of the second millennium before the Christian era must have been tiny affairs, for the same area nowadays contains scarcely half as many *hsien* or townships. The average size of the modern *hsien* in Shantung, for example, is, according to R. F. Johnston,[17] only 520 square miles. As Professor Parker remarks, in early times the "country" of each feudal chief was his mud village and the few square miles of fields around it.

The tie which bound these primitive little states together in the sort of loose confederation which seems to have existed was not political but

[15] On the legends see H. Kurz: Mémoire sur l'état politique et religieux de la Chine, 2300 ans avant notre ère, selon le Chou king, *Journ. Asiatique*, 2nd Ser., Vol. 5, 1830, pp. 401–436 and Vol. 6, pp. 401–451; Léon de Rosny: Shan-haï-king, Paris, 1891, *passim;* M. Bazin ainé: Notice du Chan-haï-king, cosmographie fabuleuse attribuée au Grand Yu, *Journ. Asiatique*, 3rd Ser., Vol. 8, 1839, pp. 337–339; John Ross, *op. cit.*, Ch. 1; Léon Wieger: Textes historiques, Shanghai, 1903, pp. 23–47; Chavannes, *op. cit.*, Vol. 1, Ch. 1; Wang Ch'ung: Lun-Hêng (Alfred Forke's transl., 2 vols., 1907), *passim*.

[16] See Kanichi Asakawa: The Early Institutional Life of Japan, Tokyo, 1903, p. 188; also Wieger, *op. cit.*, p. 103.

[17] R. F. Johnston: Lion and Dragon in Northern China, London, 1910, p. 16.

religious. Its outward manifestation consisted in the common periodical worship of the sky, whose chief minister, the T'ien Tzŭ, or "Son of Heaven," was far more a priest than he was a king, although he seems already, three or four thousand years ago, to have evolved beyond the stage where he was actually a god himself, *in propria persona*.

Importance of the Fên and Lo Valleys

For the first two thousand years or so after its emergence from the Wei valley the old Chinese civilization was confined almost wholly to the banks of the Hwang Ho and its affluents. Among the latter, one of the most important was the Fên, in southwestern Shansi, whose valley was apparently

Fig. 9—On the upper Yangtze near the upper end of the Gorges; style of boat known as a *wu-pan*.

one of the earliest occupied and where in time there grew up a powerful state. There are reasons, indeed, for believing that this region was a center of Chinese culture even earlier than the valley of the lower Hwang Ho itself. Many of the oldest legends are localized here, and the earliest dynasty, that of the Hsia, is said to have been centered here. The important state which occupied this area during much of the first millennium before the Christian era retained the use of the very ancient Hsia calendar, with the year beginning in March. Another center of civilization was the valley of the Lo, which flows into the Hwang Ho from the southwest in what is now north-central Honan. Its importance was mainly due to the fact that it formed, with a short and easy portage, the best avenue of communication with the Yangtze basin. This route dates back to the earliest recorded times and undoubtedly exerted a controlling influence in the dissemination of the Bronze Age culture southward from prehistoric ages onward. In the opposite direction the farthest outposts of Chinese civilization were located

on either side of the mouth of the Hwang Ho, which then entered the Gulf of Chihli near the modern Tientsin.

The one instance in which the protohistoric Chinese spread beyond the Hwang Ho basin was in the case of the Hwai River, whose headwaters, in central Honan, they occupied at an early date. But the conquest of the middle and lower course of this stream was quite beyond their power. A half-drowned region inhabited by a stubborn race who fought largely from canoes, the Chinese with their clumsy war chariots could do nothing with it, and it remained independent for something like two thousand years. The thickly forested mountains of Shansi and Shantung and the height of land bounding the Hwang Ho basin on the southwest also remained un-

FIG. 10—Hwang Ho (Yellow River), from the crossing of the Peking-Hankow railway, at low water.

conquered,[18] as did the regions near the seacoast. The fact was that, as is commonly the case with early civilizations, that of Bronze Age China, while admirably adapted for the particular sort of environment in which it was evolved, possessed little flexibility or power of adjustment. Based fundamentally upon the plow in peace and the chariot in war, in hilly or wooded country or in regions of jungle or swamp it found itself helpless; and such areas, whether as frontier lands or as enclaves surrounded by the civilized Chinese states, remained free and unassimilated for ages.

Toward the close of the second millennium before the Christian era a fresh access of culture influences from the West reached northern China in

[18] On the ancient forests of China, see the Shi King ("Odes") *passim;* Mencius (Legge's transl.), Vol. 1, Part I, Ch. 3, par. 3; J. J. M. de Groot: The Religious System of China, 6 vols., Leiden, 1892–1910; reference in Vol. 5, p. 660 *et sqq.;* Édouard Biot: Recherches sur les mœurs des anciens Chinois, d'après le Chi-king, *Journ. Asiatique*, 4th Ser., Vol. 2, 1843, pp. 307–355 and 430–447; reference on p. 323; and *idem:* Le Tcheou-li, ou Rites des Tcheou, 2 vols., Paris, 1851, Ch. 37. For an interesting description of the last existing bit of the ancient North China forest, see A. W. S. Wingate: Nine Years' Survey and Exploration in Northern and Central China, *Geogr. Journ.*, Vol. 29, 1907, pp. 174–200 and 273–306.

connection with what is known historically as the Chou conquest. And here again it is the Wei basin that is found playing the leading part.

The Chou Conquest from the Wei Basin

Lying at the eastern extremity of the ancient line of culture drift across Asia and separated from the North China plain by somewhat definite mountain barriers, this basin has played the part time after time of a storage reservoir in which both fragments of peoples and scraps of civilizations have found lodgment. Under the influence of such highly complex stimuli a culture would be formed there, only to overflow at length upon the rich plains to the eastward and there undergo a further and larger development along the lines already determined for it. The Chou conquest of China, while probably far from being the first instance of this process, is the earliest of which we have actual historical accounts.

The Chous, when we first hear of them, are found dwelling in the upper portion of the Wei basin. Who they were, or whence they came, we do not know. Racially they were probably rather closely akin to the early Chinese. But one of their oldest myths claimed for their ruling house descent from a maiden mother and miraculously conceived son of a familiar West Asiatic type and, like the latter, patron divinities of agriculture.[19] Moreover the Chous introduced into the Hwang Ho valley the harem system with eunuch attendants so well established in Babylonia and adjacent lands but hitherto unknown in China. And in the period immediately succeeding their conquest of China proper they were in touch with places in the west which are apparently to be sought for in the Tarim or Turfan regions.

During the first three centuries or so of their rule over China proper the Chous retained their headquarters in the Wei basin, although they established a secondary capital in their newly won possessions to which they made royal progresses from time to time, to offer the great state sacrifices and receive the homage of the assembled feudal lords. For some time they appear to have entertained designs of conquering the nearer portions of the Yangtze valley, and several of their early rulers are recorded as having invaded those regions. But they achieved no permanent annexations, and the southern frontier of the Chinese culture area in the early part of the first millennium before the Christian era seems to have been pretty much where it had been for the past thousand years or more, along the water parting between the Hwang Ho and the Yangtze.[20]

Eventually, in the eighth century before Christ, the ruling house of the Chous, already greatly weakened by internal decay as well as by various external causes, were forced out of their ancient seats in the Wei valley by

[19] See on this Legge, Sacred Books of the East, Vol. 3, pp. 319 *et seq.*, 396, 398, and footnote 1; also Chavannes, *op. cit.*, Vol. 1, p. 209 *et seq.* This concept of a Mother Goddess and Divine Son, particularly as patrons of agriculture, is of course well known in the Occident, especially in Asia Minor and Syria.

[20] For an interesting account of the founding of a town in this region (modern Fêng-chou, Nan-yang prefecture, Honan) as an outpost against a non-Chinese people, see Legge, Sacred Books of the East, Vol. 2, p. 424 and footnote 1.

predatory tribes from the west and compelled to remove to their eastern capital of Loyang, on the Lo River, in ancient China proper. Thus deprived of their old native territorial and fiscal base,[21] they speedily lost what little remained to them of temporal power and degenerated into a line of *fainéant* priest kings whose sacerdotal character alone secured for them a further existence of several centuries. None of the Chinese states which had grown up out of the fiefs they had apportioned out after their conquest of China ever ventured, indeed, upon the sacrilege of overthrowing them; and the extinction of their line was the work of a fresh invasion from the west in the third century before Christ.

Climatic Cycles and Folk Movements

Here parenthetical remark may be made regarding a curious set of coincidences in connection with the early history of civilization in China. Ellsworth Huntington has shown[22] that there has occurred in Babylonia and the eastern Mediterranean region a succession of periods of humidity and general prosperity alternating with others of dryness and general disturbances. These periods he has traced from around 2200 B. C. to 750 B. C. The striking parallelism with contemporaneous conditions in China can best be presented in tabular form:

Occident		China	
2200 to 1750 B. C.	Period of humidity and general prosperity and progress	2205 B. C.	First dynasty founded
1700	Center of period of dryness with invasions from the desert and domestic disturbances	1766	First dynasty overthrown by a popular revolt following seven years of drought
13th century	Period of dryness with consequent famines, domestic turmoil, and invasions	1122	Second dynasty overthrown by popular revolt and invasion from the west
870 to 750	Probably somewhat dry period	842 to 771	Period of turmoil and invasion from the west; great drought, accompanied by disturbances, recorded for about 822 B. C.

[21] Wang Ch'ung (Lun-Hêng, Alfred Forke's transl., 2 vols., 1907; reference in Vol. 1, p. 438) says that Wu Wang, the founder of the Chou line, relied on the people of his original fief of Chou, in the Wei valley, to fight his battles for him, and that all the early dynasties regarded the district of their origin as the basis of their power. Cordier (*op. cit.*, Vol. 1, p. 127) says that the decadence of the Chous began with their removal to Loyang.

[22] Ellsworth Huntington: Palestine and Its Transformation, Boston and New York, 1911, pp. 383–398.

These coincidences seem almost too numerous and too exact to be purely fortuitous. Perhaps we may at least take them as indicating that the major periods of humidity and of aridity have made their influence felt in precisely the same way at both extremities of the Asiatic continent.

The Introduction of Iron

It was probably about the middle of the Chou period, or somewhere about the eighth or seventh centuries before Christ that bronze as the predominant metal in Chinese civilization began to yield its supremacy to iron. That iron was known in western Asia before it reached the central and eastern portions of the continent seems probable. De Morgan[23] remarks that it was already in common use in Assyria, Asia Minor, and Armenia before it penetrated to the regions east of the Caspian. According to the British Museum's "Guide to the Antiquities of the Bronze Age" (1904) iron was not generally employed in Mesopotamia till about 1000 B. C., while the "Guide to the Antiquities of the Early Iron Age" (1905) gives the same date as approximately marking the end of the exclusive bronze culture in classical lands. W. M. Flinders Petrie[24] says that iron was introduced into Egypt about 800 B. C., while Professor Ridgeway[25] gives about 860 B. C. as the date of the earliest mention of iron in the Assyrian tablets. Hence, unless we suppose that the Chinese worked out independently the method of reducing iron ores, which while of course not impossible seems on the whole unlikely, the ascription of its earliest use by them to the eighth century before Christ or thereabout seems in the light of our present knowledge most probable.[26]

The Yü-kung, or "Tribute of Yü," which in its present form seems to date from about that time or perhaps a century or so earlier,[27] speaks of gold, silver, and copper as "the three metals" but states that iron is obtained from Liang Chou, a western region which included at least part of the modern province of Kansu. And there can be little doubt that it was by this age-old Central Asiatic route to the headwaters of the Wei that the Chinese obtained their knowledge of the new metal. Its employment seems at first to have been confined, as in other lands, to the fabrication of domestic utensils, bronze being retained for weapons and ceremonial objects.

[23] J. de Morgan: Mission scientifique au Caucase: Études archéologiques et historiques, 2 vols., Paris, 1889; reference in Vol. 1, p. 38.

[24] W. M. Flinders Petrie: Ten Years' Digging in Egypt, 1881–1891, New York, n. d., p. 152.

[25] William Ridgeway: The Early Age of Greece, 2 vols., Cambridge, 1901; reference in Vol. 1, p. 616.

[26] Taxes are mentioned as levied on iron in the seventh century before Christ (Forke, *op. cit.*, Vol. 2, p. 72, footnote 5). De Groot (Religious System, Vol. 1, p. 287) says merely that iron was in general use in China during the Chou period (1122–255 B. C.). De Mortillet, on the other hand (*loc. cit.*, p. 399), says that bronze was not replaced by iron in China until the Ch'in Dynasty (late in the third century before Christ). There is a solitary statement (see Wieger, *op. cit.*, p. 59, and Biot, Mœurs, p. 332) to the effect that iron was mined and made into swords as far back as around 1800 B. C., but in the light of the other evidence this is surely an anachronism. The question is discussed at length by Professor Hirth in his "Chinesische Ansichten über Bronzetrommeln," Leipzig, 1904, p. 17 *et seq.*

[27] On the dating of the *Yü-kung* see Chavannes, *op. cit.*, p. cxli; Legge, Shu King, Sacred Books of the East, Vol. 3, p. 64, footnote 1; Arthur Morley: A Study in Early Chinese Religion, *New China Rev.*, Vol. 1, 1919, pp. 176–208, 262–281, and 372–384; reference on p. 177; and *idem*, "The Yü-kung Classic," *Chinese Recorder*, Vol. 45, 1914, p. 238 *et seq.*

FIG. 11

FIG. 12

FIG. 11—The road from Loyang to Sian fu, called by Richthofen "the worst road in China." In the distance the loess scarp marks the edge of the valley (of a small southern affluent of the Wei). These loess bluffs are in many places honeycombed with artificial caves used as dwellings.

FIG. 12—Hamlet of Yün-Kang in northern Shansi. Famous Buddhist grottoes of the fifth century of our era, located here, formed in their prime the worshipping place of emperors and the object of pilgrimages. They are now practically deserted and almost unknown. The picture shows a very primitive type of ox cart. Notice the wheels without spokes.

The Kingdom of Chou in the Yangtze Valley

While there are earlier allusions to the area and its people, the first references to the cultural development of the Yangtze valley region date early in the first millennium before the Christian era. We then find rising there, on the north bank a little way below the famous gorges, the "barbarian," or non-Chinese, kingdom of Ch'u. The old Chinese name for this region was Ching Chou, or "Jungle-Land," and the character with which the name Ch'u itself is written contains as one of its elements the symbol for a forest. The delay of two thousand years which occurred before the Chinese culture succeeded in penetrating this area from the Hwang Ho valley, only a short distance to the north, was undoubtedly in great part due to the thickly forested character of this ancient lake bed, now one of the most densely populated and intensively cultivated portions of all China.

There is some reason to believe that the ruling element, at least, in Ch'u was of the great and highly gifted T'ai race, of which the Siamese, the Shans, and the Laos are the best known modern representatives.[28] At all events its growth was steady, and it rapidly became the leading state of the great valley, exercising a vague suzerainty even as far as the sea. But it was not until the latter part of the fourth century before Christ that it attained to its greatest power. At that time it had pushed its conquests up the Yangtze and its affluent, the Han, into eastern Szechwan and southern Shensi, on the one hand; while, on the other, it had after a savage struggle definitely subjugated and annexed the entire valley as far as the sea and had even made tributary the coastal regions extending southward from the mouth of the Yangtze. It had further succeeded, as the Chinese themselves had never done, in subduing the stubborn inhabitants of the Hwai valley; and it had also made important annexations among the native Chinese states in the Hwang Ho valley itself. Finally, toward the close of the century it despatched an army up the Yangtze to seize the Ta-li fu region in western Yünnan, in part no doubt for the purpose of securing control of the trade from Indian regions which was likely otherwise to be diverted northeastward, through Szechwan, to the rival state of Ch'in, then coming into prominence in the historic old Wei River basin.

Early Cultural Foci in the West

Meanwhile, in the Yangtze valley above Ch'u two independent culture foci had appeared, in the valleys of the Chia-ling and the Min, in the modern Szechwan. Here, as might be expected, Indian influences appear to have been particularly strong.[29] Rice and sugar cane remain to this day among the staple cultivated plants, while the water buffalo and the zebu, or humped

[28] Cochrane, *op. cit.*, pp. 4, 17, and 19; J. H. Freeman, *Chinese Recorder*, Vol. 49, 1918, p. 456; Gazetteer of Upper Burma and the Shan States, Rangoon, 1901, Part 1, Vol. 1, p. 187 *et seq.*

[29] For the first historical mention of trade between this region and India, in the second century before Christ, see A. Wylie: History of the South-Western Barbarians and Chaou-seen. Transl. from the "Tseen Han Shoo," Bk. 95. *Journ. Anthropol. Inst.*, Vol. 9, 1880, pp. 53–87; reference on p. 59.

Indian ox, figure prominently among the domestic animals. The details of hut construction among the peasantry are identical with those now or formerly extending over the whole of the Indo-Chinese area taken in its widest sense.

Farther west still the territory comprised within the west-central portion of the modern province of Yünnan was from the earliest times in close contact with the lands about the head of the Bay of Bengal. In this latter region, according to most authorities, originated the cultivation of irrigated rice with the aid of the water buffalo; and it was apparently by the Burma-Yünnan route that it penetrated to the Yangtze valley and in time to South

FIG. 13—So-called "Persian" water wheels outside the city wall of Ch'eng-tu, the capital of Szechwan and of the ancient kingdom of Shuh; the wheels are made of bamboo and are about 40 feet in diameter.

China generally. This cultivation appears the essential requisite to any cultural advance in southeastern Asia.[30] It was perhaps the acquisition of this staple foodstuff that eventually led to the rise of the large Yangtze River powers, from Szechwan to the sea, just as the cultivation of millet and wheat was what made possible the Chinese civilization of the Wei and Hwang Ho valleys, two thousand years earlier.

THE MARITIME STATES OF WU AND YÜEH

At the other extremity of the great river, in the region about its lower course and embouchure, shortly before the middle of the first millennium before the Christian era there arose the state of Wu, supposed by some to

[30] W. W. Skeat and C. O. Blagden: Pagan Races of the Malay Peninsula, 2 vols., London, 1906; reference in Vol. 2, p. 451.

have been peopled by a stock akin to the modern Annamites. By means of fleets of large war canoes—ancestors of the modern "Dragon boats" of festival fame[21]—this kingdom managed to render tributary much of the Chinese seaboard. It also carried on with its ancient suzerain, Ch'u, a long and bitterly contested war, in the course of which it took and sacked Ch'u's capital. Wu seems, however, to have tried to do too much and to have exhausted itself in the effort; for early in the fifth century before Christ it collapsed, completely and once for all, before an assault by a state of kindred stock and culture just to the south, known as Yüeh, whose capital was located on the southern shore of the Bay of Hangchow. This state, even more purely a maritime power than Wu, rapidly extended its conquests up and down the coast as well as along some of the inland waterways and even for almost a century located its capital on that Kiaochow Bay in Shantung about which we have been hearing so much during the past few years. Eventually, however, in the fourth century before Christ it was conquered and incorporated by Ch'u, which at the same time laid under tribute the seaboard regions farther south. But Ch'u, with its administrative center a thousand miles up the Yangtze, could exert little influence in regions so distant; and these coast lands, composed of a large number of separate small principalities, appear speedily to have regained their complete independence.

And now it is necessary to turn once more to that Wei River valley already so often mentioned, whose geographical position affords the key to the development of Chinese civilization from prehistoric times.

The Contest Between Southern and Western Cultures

The fundamental fact in the creation of the Chinese Empire as the centralized, bureaucratic, and theoretically absolute monarchy which existed until the other day is the tremendous century-long struggle between the states of Ch'u with its essentially Indo-Chinese culture, on the one hand, and of Ch'in with its Central Asiatic affinities, on the other, for the mastery of the Yangtze valley. It was a struggle *à outrance*, in which there could be neither compromise nor giving of quarter. It entailed for the victorious power such success as rarely falls to the lot of any people; but for the loser, nothing short of total annihilation as a distinct ethnic and political entity.

Of the growth of Ch'u a sketch has already been given. The rise of its great opponent, the state of Ch'in, dates from the time when the Chous, in the eighth century before Christ upon evacuating their ancient western seats, made its ruler, until then a mere petty feudal chieftain, Warden of the

[21] On Wu's raids by sea and river see Legge, Chinese Classics, Vol. 5, Part II, p. 281. The fleets in which the coast peoples raided one another as well as the Chinese up the inland waterways undoubtedly consisted of great war canoes like those used by the Indo-Chinese nations almost universally until a few generations ago. See on these Col. A. Lane Fox: On Early Modes of Navigation, *Journ. Anthropol. Inst.*, Vol. 4, 1875, pp. 399–437; reference on p. 404 *et seq.*; Mrs. Ernest Hart, Picturesque Burma, Past and Present, London, 1897, p. 118.

On the modern Chinese "dragon boat" used in connection with the festival held on the fifth of the fifth moon, see Lewis Hodous: The Great Summer Festival of China as Observed in Foochow, *Journ. North-China Branch of the Royal Asiatic Soc.*, Vol. 43, 1912, pp. 69–80; reference on p. 76; J. J. M. de Groot: Les fêtes annuellement célébrées à Emoui (Amoy), 2 vols., Paris, 1886; reference in Vol. 1, p. 347.

Western Marches. Turkic relationship has been asserted for the people of this state,[32] and certain it is that in many ways they stand clearly differentiated from the natives of the ancient Chinese culture states of the North China plain. Warlike, ambitious, and savagely cruel on occasion, they were at the same time intelligent and progressive, and in their political, military, and economic organization were far ahead of China proper.

All that we know of the history of Ch'in, aside from the scanty information afforded by a few brief inscriptions,[33] is derived from the Chinese, who were bitterly hostile to it and who ascribed every advance in civilization which it made to the advice of various traitor Chinese refugees at its court. The cultural evidence, however, points strongly the other way, toward western Asia and particularly toward Persia, as the region whence Ch'in derived much of its civilization. The Persian Empire during the fourth century before Christ, it will be remembered, reached as far as the Jaxartes and the Indus, while Ch'in about the same period took in much of Kansu and portions of Szechwan, termini, respectively, of important trade routes from precisely the Jaxartes and Indus valleys.[34] As a consequence of these commercial relations the name "Ch'in" began to be known in western regions some centuries before the Christian era, and came to be applied by a species of geographical synecdoche to the whole Chinese culture area—an application which survives to this day in the majority of European languages. The Persians seem to have known of silk, which even reached Greece in small quantities at least as early as the fourth century before Christ. The Ch'in of the following century, we know, was aware of the existence of the Hellenic kingdom of Bactria, even beyond which, in one of its inscriptions, it claimed to have penetrated.[35] The great palace of Shih Hwang-ti, the most famous ruler of the House of Ch'in, as described to us by Chinese writers, though built of wood yet seems clearly of the western Asiatic rather than the Chinese type of that period;[36] it certainly impressed the contemporary Chinese as a very remarkable building, and apparently not wholly because of its vast size. And

[32] Chavannes, Mémoires historiques. Cordier disagrees with Chavannes. See Legge, Chinese Classics, Vol. 4, Prolegomena, p. 141.

[33] Édouard Chavannes: Les inscriptions des Ts'in, *Journ. Asiatique*, 9th Ser., Vol. 1, 1893, pp. 473–521; reference on p. 481 *et seq.*

[34] On the old trade routes between China and the Occident see von Richthofen, *op. cit.*, Vol. 1, p. 459 *et seq.*; Sir M. A. Stein: Ancient Khotan, 2 vols., Oxford, 1907; reference in Vol. 1, p. 52 *et seq.*; Albert Herrmann: Die alten Seidenstrassen zwischen China und Syrien: Göttingen, 1910. Von Richthofen in his map in Vol. 1, opp. p. 385, puts the northwestern border of Ch'in at about the modern Lan-chou Fu, in Kansu, and fails altogether to show the annexation of Szechwan and the upper Yangtze basin by that state.

[35] Chavannes, Inscriptions, p. 500. On the relations between Bactria and China see Reinaud, Relations politiques et commerciales de l'Empire Romain avec l'Asie orientale, *Journ. Asiatique*, Ser. 6, Vol. 1, 1863, pp. 93–234 and 297–441; reference on p. 113, footnote 1. W. W. Tarn (Notes on Hellenism in Bactria and India, *Journ. of Hellenic Studies*, Vol. 22, 1902, pp. 268–293) remarks (p. 291) that the Bactrians apparently had access to the rich Central Asian gold deposits of the Altai till the reign of Eucratides, when they were cut off from them by the great tribal movements instituted by the conquests of the Huns and thinks that there probably was a good deal of trade between China and the West before the time of the Han emperor Wu-ti (c. 100 B. C.), when it is generally said to have commenced.

[36] For a description of this edifice see Wieger, *op. cit.* p. 269. On the spread of Persian architectural influences eastward, see E. B. Havell: The Ancient and Medieval Architecture of India: A Study of Indo-Aryan Civilization, London, 1915, p. 2 and *passim:* also Marcel Dieulafoy: Les piliers funéraires et les lions de Ya-tcheou fou, *Comptes rendus des Séances de l'Académie des Inscriptions et Belles Lettres*, 1910, pp. 362–377.

the court etiquette of Ch'in was decidedly Persian in many ways; any one, for example, who dared enter the Presence unbidden risked his life thereby. The whole institution of kingship in Ch'in, as a matter of fact, was far more developed and politicized than was the case anywhere in contemporary China. Hence even though Ch'in may never have come in direct contact with Persia—may never even have heard of such a country, though this is most unlikely—it seems quite certain that culturally it was deeply influenced by that great empire.

By the beginning of the fourth century before Christ the ten thousand small states which legend tells us once existed in the valley of the Hwang Ho had nearly all been consolidated into a few great ones, all of them contending for the supremacy but none of them able to achieve it. The T'ien Tzŭ, long since shorn of all temporal power, dwelt secluded and impoverished in his capital of Loyang, feared by none and reverenced, if at all, merely for his time-honored claim to be in some special way the intermediary between man and Heaven.

Strategic Importance of the Yangtze Valley

The great non-Chinese kingdoms of Ch'u and Ch'in, on the other hand, were steadily growing more powerful and more menacing. Their opportunities for expansion at the expense of less civilized neighboring peoples were practically unlimited; their wealth of natural resources was such as would be accounted vast even today; and between them they controlled the only routes by which Western culture stimuli could reach China. There is, furthermore, some reason to believe that they had progressed further than the Chinese proper in the application of iron to the uses of war—an advantage which it would be impossible to exaggerate. The direct evidence for this is slight, but it seems probable in view of the superior opportunities enjoyed by Ch'in and Ch'u for receiving culture stimuli from the West, and their very evident superiority in war to the peoples of the ancient China proper along the Hwang Ho. Ch'ing, whose swords were specially prized, is identified by Biot[37] with a fief in the Wei valley; Wu and Yüeh are represented as eager for the iron of Ch'u in order to make weapons of it.[38] It was apparent that to either Ch'u or Ch'in was destined the mastery of southeastern Asia. And success was assured to that one which could secure and retain control of the Yangtze valley. The key to the Yangtze was the Han-chung region, on the extreme upper waters of the Han, in what is now southwestern Shensi. This region had been occupied at an early date by Ch'u, by whom its vital strategic significance was thoroughly understood; but after a long and bloody contest it was finally wrested away by Ch'in, who also about the same time—the last quarter of the fourth century—annexed the two culture areas in Szechwan, the basins of the Chia-ling and the Min.[39]

[37] Biot, Tcheou-li, Ch. 40, section 10 and note.

[38] Albert Tschèpe: L'histoire du royaume de Tch'ou, Shanghai, 1903, p. 42, footnote 2.

[39] *Ibid.*, p. 206; also Rev. Thomas Torrance: The Early History of Chengtu, Chengtu, Szechwan, 1916, p. 2 *et seq.*

Once the grasp of Ch'in upon the Han-chung and Szechwan regions was firmly established, the final overthrow of Ch'u and the conquest of the small, feeble, and disunited states of the Hwang Ho valley was only a question of time. Ch'u, however, resisted desperately, and the struggle was protracted, with varying fortunes, for almost a century longer. Even to the very last, by superhuman efforts Ch'u managed to hurl back again and again vast armies of the invaders. But Ch'in fought with the same obstinacy and determination that the Roman Republic was displaying during the same period in its two earlier wars with Carthage. Ch'u in the long run was forced back step by step out of its native Yangtze valley into the basin of the Hwai. When the final catastrophe came, the Ch'u capital was in

FIG. 14—Hwa Shan, the Sacred Mountain of the West, shortly after sunrise. It is situated south of the Wei River, in eastern Shensi.

northwestern Anhui, just south of the Hwai River and some three hundred miles northeast of its original location in what is now Hupeh province.

CONSOLIDATION OF CHINA UNDER THE FIRST EMPEROR

Ch'in found time, in the course of this Hundred Years' War, to annex most of the Chinese states of the Hwang Ho valley. Ch'u was finally blotted out in 223 B. C., and two years later the last of the old Chinese states, that of Ch'i, in Shantung, shared its fate. This task accomplished, the ruler of Ch'in, who up to that time had held the comparatively modest rank of *Wang*, or king, consolidated his conquests, provided them with a centralized bureaucratic government, and himself assumed the title of Shih Hwang-ti[40] or First Sovereign Emperor. It is difficult not to see in all this the influence of the careers of Cyrus and Darius and Alexander, and perhaps

[40] "Hwang" here is an entirely different word from that which means "yellow," although spelt precisely like it in English; to the Chinese the difference in the characters makes the distinction clear enough.

too of Chandragupta and Asoka. Be that as it may, the work of Shih Hwang-ti was far more lasting than that of any of these. Probably no greater political genius ever lived. Certainly his achievement of knitting together a single empire out of such hostile and discordant elements so firmly that it still coheres after the stresses and storms of over two thousand years, is a feat never equaled by any other man.

Soon after his assumption of the new Imperial title Shih Hwang-ti undertook to add to his dominions the southern maritime regions, never hitherto effectively conquered by any of the civilized Powers farther north. For this purpose he gathered a vast army of soldier colonists numbering, it is said, half a million men. In this invasion the fullest possible use was made of the rivers, a simultaneous advance being made over five different routes. The principal of these seems to have been in part that followed by the railway now in process of building between Hankow and Canton. From the Tungting Lake it ascended the valley of the Siang River into what is now northeastern Kwangsi. At this point the great emperor had a canal dug to connect the waters of the Yangtze basin with those of the Cassia, a member of the great West River system. The invasion, like all else that the emperor undertook, was successful, and as long as he lived his power was acknowledged well down in what is now French Indo-China. After his death, however, his viceroy set up for himself, and it was not until nearly 100 B. C. that the South was again conquered for the Chinese Empire.

To the north and northwest, beyond the upper course of the Hwang Ho, conditions of a totally different order had to be met. Here was a semiarid region of boundless plains, inhabited by fierce horse-riding nomads[41] whom it was utterly impossible either to control or to exterminate. Shih Hwang-ti's policy toward these was one of exclusion and defense—a policy which found its most tangible and lasting expression in the building of the Great Wall by his orders.

With the establishment of the Ch'in Empire the history of ancient China comes to an end. The Ch'in Dynasty itself soon passed away; but its work has endured. Whatever political structure may finally be erected in China will perforce have to conform to the foundations so firmly laid by that great princely house of which the First Sovereign Emperor was the most illustrious, as he was almost the last, representative.

In another sense also the Ch'in period marks the end of an era. Up to that time it seems quite certain that all cultural elements from the civilized lands of the Occident had entered China by the upper waters of one or other of her two great rivers. But under the succeeding dynasty of the Han began that oversea intercourse with distant nations which has been going on ever since in steadily increasing volume until now it vastly exceeds in importance that carried on overland along the ancient trade routes up the valleys of the Hwang Ho and the Yangtze Kiang.

[41] H. H. Howorth: The Northern Frontagers of China, *Journ. Royal Asiatic Soc.*, 1898, pp. 467–502; Fr. Hirth: The Ancient History of China to the End of the Chou Dynasty, New York, 1908, p. 67.

But, with the growth of population in the interior of Asia and the attendant development of internal commerce that are bound to come, these old westward roads are destined one day to resume their former importance, and the same geographical factors which determined the direction and form of the civilization of the China of the Bronze Age will once more reassert themselves, with consequences to Siberia, to southeastern Asia, and to the world at large, which no one can as yet foresee.

EXPLORATION IN THE LAND OF THE YURACARÉS, EASTERN BOLIVIA

By KIRTLEY F. MATHER
Denison University

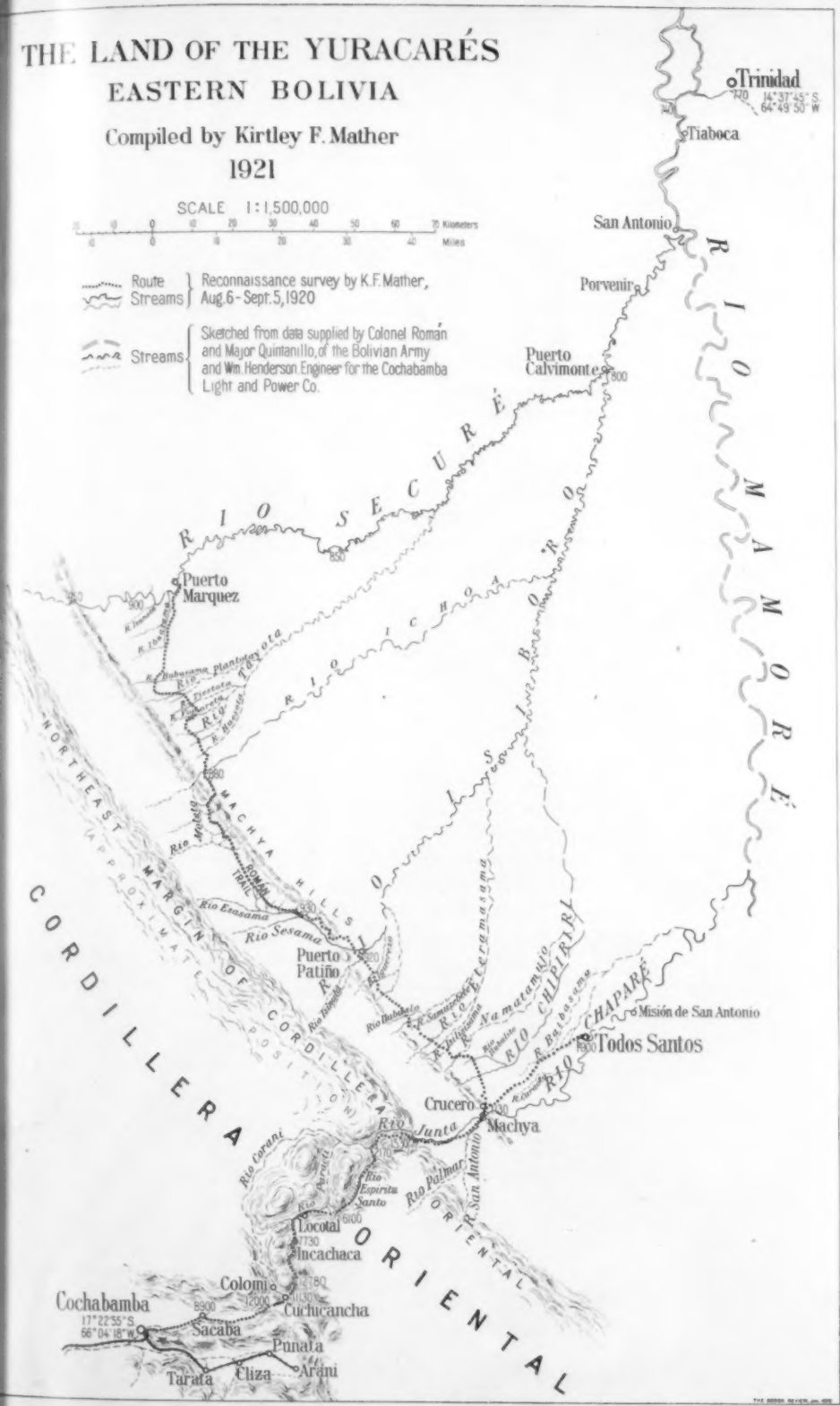
League upon league of monotonous, water-soaked, jungle-covered plain densely forested; brown streams, gliding silently down winding channels, occasionally lashed into foam by giant snags, a deadly menace to the incautious canoeist; rarely, a tiny *chacra*, or clearing, with a dozen banana trees and a patch of yuca, a palm-thatched hut, and a dugout canoe—this is the land of the Yuracarés, an Indian tribe of eastern Bolivia. The land of the Yuracarés occupies the little-known southwestern corner of the vast Amazon Basin where there still exists many a "river of doubt" waiting the time when some adventurous explorer shall chart its tortuous pathway. Its rivers are all affluents of the mile-wide Mamoré, one of the larger heads of the Madeira which in turn is one of the largest of the tributaries to the Amazon.

This land is today crossed by one of the South American transcontinental routes of trade and travel, but as yet none of the published maps of Bolivia show its geography with even approximate accuracy. Travelers have hitherto confined their attention to the main thoroughfare; the adjacent regions have scarcely been explored. The accompanying map (Fig. 1), which is based on reconnaissance traverses with pocket compass amplified by information obtained from local inhabitants, is one of the first to portray the geography of this region with any attempt at accuracy.

The land of the Yuracarés is bordered on the southwest by the ramparts of the Andes, the successive steep-walled ridges of which effectively separate eastern Bolivia from the high plateau of comparatively populous western Bolivia. Across the Cochabamban section of the Andes there leads a single treacherous trail, significantly named "Sal Si Puedes" (pass if you can), whose hundred miles form the only difficult part of the transcontinental journey. From the upper end of this trail at the town of Cochabamba there is direct rail communication to the Pacific coast at Arica; from its lower end at Todos Santos there is more or less trustworthy connection by river steamers of varying dimensions and comforts all the way to the mouth of the Amazon at Pará. But in the land of the Yuracarés there are only two modes of transportation—on foot or in canoe.

TODOS SANTOS AND THE RIO CHAPARÉ

My party of five, three gringos and two Bolivians, bent on exploring the upper reaches of the Rio Securé, reached Todos Santos on August 12,


THE LAND OF THE YURACARÉS
EASTERN BOLIVIA
Compiled by Kirtley F. Mather
1921
SCALE 1:1,500,000
Kilometers
Miles
Route
Streams
Reconnaissance survey by K.F. Mather, Aug. 6 - Sept. 5, 1920
Streams
Sketched from data supplied by Colonel Román and Major Quintanilla, of the Bolivian Army and Wm. Henderson Engineer for the Cochabamba Light and Power Co.
Trinidad
14°37'45" S.
64°49'50" W
Tiaboca
San Antonio
Porvenir
Puerto Calvimonte
RIO SECURÉ
RIO MAMORÉ
RIO ICHOA
RIO ISIBORO
Puerto Marquez
Rio Ibuhama
Rio Ichoa
Rio Ibubuhama
Rio Tiquirora
Rio Tiquirora Plantation
Rio Tiquirora Chico
Rio Tiquirora Grande
Rio Tiquirora Pequeño
Rio Tiquirora Mediano
Rio Tiquirora Chiquito

1920, having crossed the mountains by the Cochabamba trail. Todos Santos is a little town of perhaps twenty houses built around three sides of a grassy square, the fourth side of which is open toward the Rio Chaparé. At this point the river is a hundred yards wide and flows between banks which during the dry season are twenty feet high but are awash during the rainy season extending from November to April. The port is at the head of navigation for a small wood-burning steamboat; but during times of low water this boat is frequently unable to ascend quite to the town and is then forced to transfer its cargo and passengers in small boats or canoes for the last few miles of the journey. Hides and alcohol from the cattle ranches and sugar plantations of the lowlands are shipped in considerable quantity up the Chaparé to Todos Santos and thence are transported on mule back to the markets on the plateau between the two ranges of the Andes. Cloth and other merchandise of foreign manufacture find their way from the Pacific coast across the mountains to this port and eventually reach consumers in the lowland towns and trading posts. Here, too, are the headquarters of the Batallón Zapadores, a part of the Corps of Engineers of the Bolivian army, which is at present doing valiant service exploring the jungles of northeastern Bolivia, cutting trails, building roads, and constructing bridges. It is less than a score of years since all this jungle was inhabited by *Chiriguanos;* yet today the machinery for a wireless station to be installed here is on its way from La Paz, and within a few months communication with the powerful radio station at Viachi will be open.

The Mission of San Antonio

August 13, 1920, was a great day for the land of the Yuracarés, although no whisper of its importance has yet been echoed abroad. On that day the Zapadores completed the trail which connects the headwaters of the Chaparé with those of the Securé and permits for the first time the passage of the jungle into which it had hitherto been possible to penetrate only a mile or two from the navigable streams. It is planned to carry this trail on across the mountains to Cochabamba and thus provide a route over which cattle may be driven from the extensive pampas north of the Rio Securé—the grasslands of the Beni—to slaughterhouses in the cities on the plateau. This work is being prosecuted under the efficient leadership of Colonel Román, and in his honor the completed portion of the trail is named the "Román Trail" on the accompanying map. It had been our intention to reach our destination on the upper Securé by canoe, going down the Chaparé to the Mamoré and down it to the mouth of the Securé, but when the Colonel told us of his new trail we changed our plans and decided to take the shorter route overland.

This meant a walk of at least ten days through the jungle, for the trail is not yet in condition for mules or even burros—I doubt if it ever will be; and therefore it was necessary to hire Indian carriers to pack the essentials of our outfit on their backs. Accordingly, we arranged to have our trunks

and boxes shipped down the rivers to Trinidad, and three of us canoed downstream to the San Antonio mission in search of carriers.[1]

Distances along the rivers in the land of the Yuracarés are invariably reckoned by the number of meander curves in the stream's course: the mission is "five turns" below Todos Santos; it took us three hours to paddle down on Saturday afternoon and seven and a half hours to pole and paddle back upstream on Sunday. We arrived there just at dusk and received a cordial welcome from Padre Fulgencio Lasingor who had been busy all afternoon caring for one of the Indian lads on whom a tree had fallen the day before. The poor boy was in a very bad condition, with a broken collar bone and a compound fracture of the arm. Among his manifold duties the padre seems to find that of physician and surgeon to his flock the most irksome; I fear that his knowledge of medicine and surgery is not quite all that could be desired when serious accidents occur.

On the bank of the river, in the midst of a clearing of several acres, there are a dozen palm-thatched huts of bamboo, all but two of which are merely roofs supported by long poles. One of these two is of course the chapel, where everybody attended mass early Sunday morning; and the other, equally of course, is the padre's home, workshop, and office. Under one of the shelters two Indian women were preparing the evening meal over an open fire, and in a few minutes we were seated at a roughhewn red cedar table, whose beautifully grained top was concealed by a square of ancient oilcloth, eating *comida* with the padre and his two overseers.

I gathered from the conversation that the mission is somewhat more an agricultural project than a religious venture. It was first established in 1905, and the present padre has been in charge for eight years. Under his direction the Indians, of whom about fifty families are attached to the place, have cleared fifty or sixty acres of jungle and are cultivating sugar cane, chocolate, tobacco, rice, yuca, potatoes, etc. The soil is extremely fertile and very deep. Apparently all kinds of things, from onions to oranges, can be grown without difficulty. Only the crudest of agricultural methods are used; there are no modern implements or machinery of any sort; the juice of the sugar cane is fermented in a hollow log trough, and from it alcohol is distilled in a huge earthenware pot. But even this is a long step in advance for Indians who a few years ago were nomad savages subsisting on fish and game, with the soft heart of a particular palm tree and now and then a little yuca as their only vegetables.

The Yuracaré Indians

The Yuracaré Indians are in the interesting transition stage between absolute savagery on the one hand and complete dependence upon white men on the other. Their territory is bordered on the southeast by that of the Sirionós, one of the wildest of Indian tribes in all South America. In

[1] For an account of the mission see also L. E. Miller: The Yuracaré Indians of Eastern Bolivia, *Geogr. Rev.*, Vol. 4, 1917, pp. 450–464.

1913 a launch ascending the Rio Ichilo for exploratory purposes was forced to turn back because of attacks upon it made by these Indians, armed with poisoned arrows; and no attempt to explore that river has since been made. The Yuracarés seem never to have had the evil reputation of the Sirionós. Gibbon, who passed down the Chaparé, described them as "half friendly to the white man."[2] At the present time the Yuracarés are completely friendly and perfectly peaceable. As I came to know them in the intimate life of camp and trail, I found them to be most agreeable comrades, happy and jovial in times of difficulty and stress, unselfishly sharing with each other the game which because of the necessity for rapid travel we had no

FIG. 2—The Rio Eteramasama, looking upstream from the crossing of the Román Trail toward the Machya Hills, which may be seen in the distance at the right.

time to secure in large amounts, dividing their burdens with scrupulous exactitude, and always alert to minister to the comforts of the *caballeros*.

The Yuracarés still retain the marvelous ability of primitive peoples to utilize the rich resources of the tropical jungle. In the absence of matches the kindling of a fire by means of fire sticks is but the work of a minute; a hemispherical depression is hollowed in the side of a stick of soft dry wood, a short rod of a particular type of hardwood, held between the palms of the hands, is rotated rapidly in this hollow, the smoldering punk which quickly forms in the depression is blown into flame, and the fire is ready. Many of the men with us carried their bows and arrows; the bows are six feet long, fashioned from the tough dark wood which forms the core of the *chonta* tree, carefully tapered at either end, and fitted with strings made by twisting shreds of the inner bark of another of the many useful trees abounding in the jungle. Because of their resistance to water, these bark strings are preferable to the imported cord of foreign manufacture, which the

[2] W. L. Herndon and Lardner Gibbon: Exploration of the Valley of the Amazon, 2 parts, Washington, D. C., 1853–54; reference in Part 2, p. 190.

Yuracarés can now easily obtain. The arrows are about five feet in length and are of cane, tipped either with a slender lance of bamboo or a long, sharp, barbed point of ironwood. With these weapons the men kept themselves fairly well supplied with fish which they shot with remarkable dexterity in nearly every stream we crossed. Our camping places were usually the abandoned shelters of the workmen on the trail, but the night of our first *chancha*, or wild pig, hunt it was necessary to construct our own huts. Four Indians in less than half an hour cleared a space in the jungle and erected a palm-thatched shed, of ample dimensions for five beds, with an absolutely water-tight roof. Their ability as woodsmen is fully equaled

FIG. 3—The ferry canoe on the Rio Sesama. At the right is a portion of the sandy *playa* which appears at low water on the inside of each meander curve along the jungle streams. Beyond the canoe on the farther bank is a clearing for yuca cultivation.

by their expert knowledge of the rivers. The canoe in which I traveled for eleven days and for which I paid thirty bolivianos (about nine dollars) was thirty feet long and four feet wide, hollowed from a tree trunk and fashioned in graceful lines. With four paddlers near the bow and one steersman astern we navigated the treacherous waters of the Securé, going upstream for three days and downstream for eight, without even a moment of fearful suspense. Yet none of the men with me had ever before been on that river.

Most of my carriers wore shirts and trousers of foreign manufacture, but some were garbed in their aboriginal costume—a one-piece garment hanging from the shoulders and caught by a string around the waist, the whole made from the inner bark of the *bibbos* tree. This bark is peeled from the tree, pounded with wooden bludgeons, further softened by chewing, and dried. When properly prepared the "cloth" thus made is very tough and durable; when new it is quite white and is generally decorated with daubs of ocher; after repeated washings it becomes a brown drab; and this change generally takes place within a few weeks, for the Yuracarés are a very cleanly people. I offered to trade a pair of trousers and a shirt for one of these *curochis*

FIG. 4—The Rio Ichoa, showing two dugout canoes ferrying the Yuracaré carriers across the deep stream from the shelter at the crossing of the Román Trail.

with an old man whom I met on the Ichoa, but he asked me to pay him cash instead. When I gave him four bolivianos ($1.25) he was more than contented with his bargain.

Only two of our men understood Spanish; the rest knew nothing but their own Yuracaré dialect. Each little tribe in eastern Bolivia has its own language, and among the Yuracarés the advent of the Jesuit or Franciscan missionary has been too recent for the adults to have acquired proficiency in the language of the white man. This multiplicity of dialects in the lowland region attracts the attention of all travelers. It is in striking contrast to the widespread use of the Quechua tongue on the high plateau of the Andes. There, with the exception of Aymará-speaking sections of Bolivia, the one Indian language is known from Ecuador to Chile throughout the entire stretch of the ancient Inca Empire; but in the jungle the dialects are nearly as numerous as the rivers. As usual among primitive peoples, the vocabulary is very small and consists almost entirely of substantives and adjectives; verbs are seldom used; inflections and gestures count for much. If a Yuracaré wishes to say that there is water in a certain place, he merely says "Sama" with a nod of the head and a gesture to indicate the direction of the locality. If there is a plentiful supply of water there, he says "Sama-sama" in the same way.

The Jungle Trail

The trail from Todos Santos to the Rio Securé is entirely in jungle country. For the most part the land is flat, lying at an altitude of approximately 1,000 feet above sea level; but between the Sesama and Ichoa Rivers a low divide is crossed, and the altitudes noted there were between 1,200 and 1,300 feet. The trail is a "slashing" through the dense tropical vegetation which keeps the ground in perpetual shadow. From Todos Santos to Crucero this slashing is thirty feet wide, and throughout most of that section the ground has been entirely cleared of stumps and projecting roots. Beyond Crucero the width of the clearing is only three or four feet, and not much care has been taken to grub out the snags along the pathway. Even in the dry season the ground is everywhere water-soaked, and in many places the mud is ankle-deep, with pools of stagnant water much deeper still. In the rainy season the whole must be an impassable quagmire, which undoubtedly renders the trail useless during those months. After the foot traveler has abandoned the notion of keeping his feet dry he has little trouble traversing this route, but 15 miles is a big day's march. Mules or burros, however, are absolutely useless; not because of the mud but because of the numerous small streams and arroyos which must be crossed. Every mile or so there is a watercourse, ten to thirty feet wide and five to fifteen feet deep, the bottom of which is a morass of mud and soft sand. Felled trees serve admirably as bridges for a man, but animals must inevitably "bog down" if they attempt to plunge through the quagmire. At the time of our visit to the region

FIG. 4—The Rio Ichoa, showing two dugout canoes ferrying the Yuracaré carriers across the deep stream from the shelter at the crossing of the Rondón Trail.

bridges were being constructed between Todos Santos and Crucero, but the needed hundred bridges farther on had not yet been even planned. Furthermore, there is absolutely no forage for cattle, horses, or mules anywhere along the entire 125 miles (200 kilometers) of trail; the work of making a cattle drive had really scarcely begun.

The general trend of the Román Trail parallels that of the eastern Andes, the Cordillera Oriental. Looking westward up the more open courses of the larger streams encountered along the trail, the rugged ridges of that cordillera, rising to altitudes of 8,000 to 12,000 feet above sea level, may be seen among the clouds which constantly shadow the range. The foot of these mountains is about 25 miles distant from the trail, but the higher peaks are twice and thrice that distance. From three to five miles west of the trail, throughout much of its length, there is a line of low hills and ridges, 50 to 200 feet above their surroundings, which also holds the same general direction, curving northwestward south of the Isiboro River and then swinging a little more toward the north between the Ichoa and Securé. North of the Sesama the trail bends sharply westward, crosses through these hills, and holds its position in the low country between them and the mountains until, near the Ichoa, it crosses back again to their eastern side. Throughout its entire length the series of low hills is apparently separated from the mountains by a belt of lowland ten to twenty miles in width. I have named this line of hills and ridges the "Machya Hills," from the army camp of that name at the point where it is cut through by the Rio Chaparé. So far as I could observe them these hills are everywhere covered with jungle vegetation similar to that on either side. Major Quintanilla of the Zapadores informed me that in laying out the route for the trail he cut his way for several miles due north from a point near the mouth of the Rio Sesama and found the country so broken by ravines and hills that it was impracticable to extend the trail that way. In some of these ravines cliffs of solid rock bordered the watercourses, whereas along the trail as it now lies there is nothing but soil, sand, and muddy clay to be seen.

The jungle as we traversed it abounded in game of all sorts. Tracks of the jaguar and panther were frequently observed, and many an evening we heard the low rumble of their voices in the distance though we never caught sight of these crafty creatures. *Wasu*, the small, short-pronged deer of the jungle, and *chanchas*, the wild pigs or peccaries of the tropics, were however not so wise. The latter run in troops of a hundred and more. Our Indians were especially gifted in the art of locating their browsing places, and the excitement of bursting through the jungle into their midst was about the only thing that broke the monotony of day after day of tramping through the mud. Monkeys, large and small, black and red, chattered at us from the trees or fled pell-mell from branch to branch high above the ground as we approached. Macaws and parrots of many brilliant hues screeched a warning far in advance of our progress, and "turkeys," ranging in size up to

FIG. 5

FIG. 6

FIG. 5—Chimani Indians on the bank of the Rio Securé.
FIG. 6—A dugout canoe on the Rio Securé, manned by Yuracaré Indians.

the five or six pound *mutun* with his brilliant crimson comb in striking contrast to his glossy greenish-black body, burst heavily from the underbrush as we passed by. Snakes there were none, and humming birds hovered blithely about their nests where their eggs were safe from all depredations except those of the monkeys. But the list of wild animals would not be complete without a mention of the *mariwis* and mosquitoes. Of the latter very few of the fever-carrying variety are in this apparently healthful region. The former, which live by the million along the banks of every stream, are bloodthirsty insects about the size of a small gnat, endowed with the ability to raise a blood blister wherever they bite.

Between the Chaparé and the Securé the trail crosses a score of streams sufficiently large to be dignified by names. The more important of these are shown on the map. All are eastward-trending and have their sources on the eastern slopes of the Cordillera Oriental. The majority are only twenty to fifty feet wide and during the dry season are less than knee-deep. Typical of such is the Rio Eteramasama. A few are of much larger dimensions, and the traveler must cross them in canoe. The first of these which we encountered was the Rio Isiboro, named on some maps Rio D'Orbigny, because that traveler during his journey across eastern Bolivia in 1840 made a camp on its banks. No regular ferry canoe has yet been placed at the trail crossing of this stream, but this will probably be done soon. Except after heavy rains, however, it is only breast-deep and hence may be forded without danger. The day we reached it had been preceded by a night of tropical deluge, and it was a foot higher than ordinarily. Much care must be used in crossing such rivers as this, for the current is very swift and snags abound. A few miles downstream, the Isiboro receives the water of the Rio Sesama, a stream of equal size; and from that point downstream to the Securé it may be navigated at all times by fairly large canoes or during the rainy season by motor boats. The Sesama is only about a quarter of a mile from Puerto Patiño, and a ferry canoe for it is always close at hand.

Some miles to the north is the Rio Ichoa, another affluent of the Isiboro and quite appreciably larger than the Sesama. It is eight or ten feet deep and 200 feet wide; its waters are probably navigable by small motor boats for some distance upstream from the trail crossing. Canoes for crossing it may be obtained from the Indians living there. No other stream, until the Securé is reached, is large enough for anything but small canoes during the dry season nor available for motor boats even during the months of high water.

At convenient distances along the trail the Zapadores have constructed stockades for the impounding of cattle and large substantial huts for the shelter of passers-by, but at only three places did we find any permanent inhabitants. The first of these was beside the Eteramasama, where two or three families of Yuracarés have established themselves. The second was Puerto Patiño, where lives the *cholo* administrator of the vast estate of Señor Patiño, Bolivia's wealthiest citizen, who makes his permanent

residence in Europe. Of the thousands of leagues of this estate, only a few score acres surrounding the *finca* in the forks of the Isiboro and the Sesama are under cultivation. The dozen or so Indian peons on the estate have cleared the jungle and replaced it by fields of sugar cane, yuca, rice, bananas, cotton, etc., and groves of orange and lemon trees. Just enough has been done to indicate the wealth of agricultural possibilities which lies dormant in this expanse of unused lands. Farther along, on either bank of the Rio Ichoa, there are three or four Indian families living in miserable palm huts surrounded during the day by clouds of *mariwis* and infested at night by a

FIG. 7—Porvenir, the well kept *finca* of the sugar plantation and cattle ranch of Sr. Nestor Suarez on the banks of the Rio Securé.

nearly equal number of mosquitoes. Their homes are adjacent to tiny clearings where only yucas are grown between the tree stumps and logs. Similar conditions exist at Puerto Marquez on the Securé, except that here there is in addition one Bolivian family who keep a few chickens; and bananas as well as yuca are cultivated.

THE RIO SECURÉ

We reached the banks of the Rio Securé at Puerto Marquez, obtained two canoes there, sent all but ten of our Indians back to the mission, provided the rest with paddles, and completed our wandering in the land of the Yuracarés by spending a week and a half on that river. First, we paddled upstream to the point where the river breaks through the Machya Hills; then we swept downstream with the swift current of the river to its mouth and on down the Mamoré to Trinidad—a succession of delightfully lazy

days after the vigorous toil of the jungle trails. Traveling upstream our canoes made only about two miles an hour, and once after traveling all day we found ourselves less than six miles in a straight line from the point where we had started in the morning, so tortuous is the course of the stream. Going downstream with the current the canoes averaged five or six miles an hour; it is generally fair to calculate that distances can be covered downstream in one-third the time required for the upstream journey.

The second night after leaving Puerto Marquez, going upstream, we camped on a sandy *playa* close to a small settlement of Chimani Indians, whose domain stretches northward from the Securé to the limits of the jungle. They were living in squalid palm shelters, about the size of a large dog house, where the women and children sat patiently brushing the *mariwis* from their faces and legs while the men fished in the teeming waters of the river or tended their tiny *chacras* of banana trees. The Chimanis never wear the bark *curochi* but have garments of the same style woven on crude looms from the native cotton. At this settlement they had quite a store of fish and bananas; our lads, though unable to converse in the Chimani tongue, were soon established on a friendly basis and made astonishing inroads upon the Chimani food supplies.

Throughout most of its course the Securé is bordered by banks of clay or sand, capped with six or eight feet of rich black soil, which rise abruptly from the water's edge to the level of the jungle-covered plain. At low water these banks are fifteen to twenty-five feet high, but in the rainy season the water spills over them and floods the ground between the trees which crowd close to the brink of the channel. Where the stream cuts through the Machya Hills, however, there is a shallow canyon with walls of maroon and carmine sandstone or vermilion and brownish-yellow shale. Between these walls the swift stream is lashed into foam at two points by gravel bars which prevent the upstream progress of all except small canoes. Our boatmen were able to ascend the first of these *cachuelas* by using poles, but at the second they had to leap into the water and half carry the canoe upstream. Between the Machya Hills at this point and the mountains, whose serrate peaks formed the distant western sky line, the lowland belt is ten or twelve miles in width.

The course of the Rio Securé is that typical of all streams in old age: extremely tortuous, with meander curve following meander curve in dizzy succession. Many times after paddling steadily around one such curve we found ourselves within a hundred yards or so of the place where we had been an hour before. The meander patterns are quite distinctive; the curve is not an arc of a circle, but is formed by short, sharp curves succeeded by comparatively straight stretches. Moreover, the dimensions of each meander seem to be a function of the stream's volume. The Tayota, the first important affluent downstream from Puerto Marquez, is not large enough appreciably to swell the waters of the master stream; but the Isiboro, which joins the Securé at Puerto Calvimonte, nearly doubles the volume. The meander

pattern immediately responds to this change in size of the river, and the length of the straight stretches between the turns is approximately doubled. Similarly, below the confluence of the Securé with the Mamoré, there is another marked increase in the dimensions of the meanders corresponding to the greater volume of water in the larger stream.

From Puerto Marquez to its mouth the Securé appeared to be quite safely navigable for motor boats drawing not more than two feet of water, even during the low stage in the river. At a few points there are snags which must be avoided, but these are not a serious obstruction to navigation. During the high water of December to May it should be perfectly feasible for small river steamers to ascend well beyond Puerto Marquez. At present, however, the river is very little used. Between the *chacras* of Señor Marquez and those of Señor Calvimonte, near the mouth of the Isiboro, the banks of the stream are lined with undisturbed jungle. Wild ducks flew up from the *playas* by the score; otters slipped from the logs along the bank where they were sunning themselves and sought safety in the brown water; river porpoises frolicked around our canoes; and occasionally a cayman drew his long snout down from off a snag and hid himself while we passed by. Once, we stopped and raided the jungle on our last *chancha* hunt in this region, the Indians having discovered in some uncanny way that a troop of peccaries was concealed near by.

Between the mouth of the Isiboro and the junction of the Securé with the Mamoré, the Securé flows close to the southern boundary of the extensive grassy plains which stretch far to the northward until the rubber forests of northernmost Bolivia are reached. On these open pampas there are many large cattle ranches. One of these, owned by Señor Nestor Suarez, has its main *finca* at Porvenir on the north bank of the Securé. This is a typical Bolivian lowlands country estate with its wooden cane press and primitive sugar refinery. It was the first outpost of modern civilization we encountered since we left Todos Santos. We spent one night there, and the second day following, as we were proceeding down the Mamoré below the mouth of the Securé, we met another sign that we were leaving behind us the wilderness of the land of the Yuracarés. This was the *Ana Catarina*, the small steamboat which plies the rivers between Trinidad and Todos Santos, chugging patiently upstream on its monthly journey. Before night we had reached the port close to Trinidad, and our wanderings in the land of the Yuracarés were ended.

It is a land of wonderful opportunity, a land of great natural resources, where untold agricultural possibilities lie dormant. These jungles are susceptible of transformation into rich plantations whence can be made an important contribution to the food supply of the world. But this transformation can never be wrought by the present inhabitants of that land. The Indian inhabitants lack the ability to work without constant supervision; their intelligence is not sufficient to permit them to rise much above their present estate. Nor does it seem likely that this transformation will

be wrought by the present white population of Bolivia. Their handicap is of quite a different sort, for they are in no way lacking in intelligence or ability. Their trouble is that they have not learned the dignity of labor. For generations they have been schooled in the principles that a workingman is low caste, that only Indians and *cholos* are expected to undertake manual labor. They are born to be lawyers, army officers, politicians, and landowners; farmers and craftsmen, never. And the combination is utterly failing to utilize the resources beyond the frontiers of civilization in Bolivia. The land of the Yuracarés will remain a jungle until a people who combine the will to work with a high order of intelligence enter it and transform it into the important food center that it may become.

NOTES ON THE FORESTS OF SOUTHEASTERN LABRADOR*

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One who has seen only the barren eastern coast of Labrador might expect a discussion of Labrador forests to rival in brevity the famous chapter on the snakes of Ireland. A cruise along the coast brings before the traveler a shore line which appears to belong to one of the most barren and treeless lands in the world. When viewing it from a distance the traveler is likely to acquiesce in Jacques Cartier's description of Labrador as "the land that God gave Cain." A short journey up any of the rivers which reach the coast of southeastern Labrador, however, will take the explorer into a densely wooded country which has no resemblance to the barren coast line and will convince him of the injustice of this description.

The coastal strip and the interior present surprising climatic contrasts which are most clearly reflected in the distribution of the forests. In passing through the Strait of Belle Isle in July a stream of floating ice and bergs is met with, which increases in volume as one proceeds up the coast. Throughout most of the month of July the vast ice fields move steadily southward under the influence of the Labrador Current, past a bleak rocky coast on which no timber can be seen (Fig. 2). The sub-Arctic climate which the southward-moving ice fields bring as far south as the Strait of Belle Isle extends but a short distance inland from the coast. In crossing the eastern threshold of the peninsula by way of Lake Melville and the "Narrows" one finds that there are two Labradors. One is a narrow coastal zone of islands and sea-facing mainland, called "the Labrador" by the cod fisherman, which is chilled by ice floes and is nearly or quite treeless. Inside this seashore strip is the heavily forested vast interior Labrador, traversed by countless streams and dotted with thousands of lakes. In this interior region salmon and trout fishing take the place of cod fishing. A summer climate replaces the ice-chilled coastal climate, and forests cover both mountains and valleys.

The observations along the coast line here recorded were made chiefly from the decks of the Newfoundland steamers, which call at the numerous fishing stations on the Labrador coast, and during a cruise on the S.S. *Acadia* to Rigolet at the entrance to Lake Melville. My earlier impressions of the coast were obtained from the deck of a sealing steamer during a cruise to the Arctic. The notes relating to the interior are based on a launch-and-

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canoe trip covering a few hundred miles of the lakes and rivers of the Lake Melville district in southeastern Labrador (Fig. 1).

The Coast Line

The route traversed in going north last season (1921) included a stop at the Bay of Seven Islands near the head of the Gulf of St. Lawrence. The heavy forests which reach the shore line at this point are being utilized by one of the largest pulp mills in Canada. The product of this mill goes to the Northcliffe papers in England.

From the intense heat of early July at the Bay of Seven Islands a short run brought the *Acadia* into the ice-cooled breezes of the Strait of Belle Isle. The first patches of snow were seen ashore near Mekatina Island on July 10. Ice fields, dotted occasionally with large bergs, were constantly alongside after we entered the Strait (Fig. 3).

With the appearance of ice on the sea comes the disappearance of forests on the shore. Bare rocky slopes without timber form the background of the southward-moving procession of bergs and floe ice.

An endless variety of shapes are represented by the icebergs. Some, as a result of irregular melting on the surface, show a crater-shaped top filled with fresh water; others have sharp pinnacles and mountain-like outlines; still others have a slightly modified tabular outline. Occasionally a berg shows a huge arch running through it, representing probably a section of a glacier which has been carved by a subglacial stream. The general color of the bergs is the purest of white, but many show a fine delicate shade of green. A few have seams of bluish green ice running through the pure white of the main mass. Some observers are impressed by the architectural suggestion conveyed by icebergs. Cabot says that "Man's architecture in all its forms is hinted at, and often the forms of living creatures, natural or grotesque; but the spirit of the ice is mainly architectural: the gods of the North had their temples, and these are their fragments."

Under a clear sky the ice floes present a striking scene. The sun is reflected from thousands of cakes of floe ice of every conceivable shape, ranging in size from a few square feet to acres of surface and extending to the sky line a dazzling field of white. Probably no other coast line shows more striking and novel mirage effects than that of Labrador. The mirage often repeats the floe inverted. Sometimes the sharp-pinnacled bergs have resting upon them their duplicates inverted, the columns and pinnacles coalescing. At the horizon the mirage often gives the appearance of a solid vertical wall of ice encircling the ship.

The distorting effect of the mirage on the low rocky islands is very interesting and remarkable (Fig. 4). The White Bear Islands and many others along the coast are low, bare, rounded masses of rock. Under the magic influence of the mirage these are made to caricature all kinds of topography. The mirage lifts up the insignificant ice-rounded hills into vertical-faced

cliffs presenting at times a vertical unbroken front of flat-topped cliffs for miles. At other times the low rocky points on the shore rise up as pillars of brown or gray rock, and these will spread out into gigantic mushrooms

FIG. 1—Sketch map of eastern Labrador.

with flat, pancake-like tops. The most common form produced by the mirage is the flat-topped mesa. But no form persists long, one type dissolving into another or giving way temporarily to the real aspect of the shore line. As one watches lofty vertical cliffs, sharply defined, rising from a low, barely visible shore, then melting away at the summits, and presently vanishing altogether, it is easy to imagine some invisible magician of the

deep, with age-long memories of the past, exhibiting some of the episodes in Labrador's geological history.

The bleak, time-eaten, rocky shores of the islands and mainland, to which the mirage gives such a variety of aspects, continue barren of trees, with a few trifling exceptions, from the western end of the Strait of Belle Isle to the vicinity of Sandwich Bay. An island in this vicinity with a few straggling spruces near the summit gave me the first hint that trees are to be found in Labrador. Other islands were seen in or near Sandwich Bay which had considerable patches of black spruce on shores which did not face the open sea. In general, however, forests are either absent on the seacoast or confined to the sides of ravines or small valleys where the topography affords some protection to timber.

Hamilton Inlet

Probably nowhere on the coast of Labrador can the transition from the barren outer islands to the forested interior be better seen than in Hamilton Inlet. This bay has a length of about 40 miles in an east-and-west direction and is dotted with numerous rocky islands. The eastern, or outermost, of these are clothed only with lichens, emerald green moss, and a considerable variety of flowering plants. Trees are entirely absent if we except a variety of arctic willow and a dwarfed birch which grow prostrate upon the ground, their branches seldom rising more than two or three inches above the rock crevices that protect their roots.

Fifteen miles to the westward the shores of the mainland and the islands begin to show patches of black spruce of a dwarfed type (Fig. 5). These show at a distance on the hill slopes as blotches of dark green on the light green of the moss-covered surrounding areas. The stunted spruce becomes somewhat larger, and the areas covered by it more extensive, as the head of the inlet is approached.

It is clear that the climatic condition resulting from floating ice is the main factor keeping the outer shores deforested. Great fields of ice persist in the outer parts of the Inlet till the latter part of July. Scattering ice cakes were seen 18 miles west of Indian Harbour near the extreme outer end of the Inlet on August 20. The ice, however, is seldom if ever seen in midsummer within many miles of Rigolet, which is situated near the head of the Inlet. Around this ice-free part of the Inlet the forests clothe a large part of the land surface; and the trees, though small, make up dense forests.

The Interior

After becoming familiar with the dwarfed spruce forests along the shores about the head of Hamilton Inlet, with trees 15 to 35 feet high, one is hardly prepared for the great change in their character which occurs in the area around Lake Melville, lying just west of the head of Hamilton Inlet. At Rigolet the visitor may see squared timbers used for hauling out vessels that would be considered creditable representatives of any Canadian forest.

FIG. 2

FIG. 3

FIG. 4

FIG. 2—A typical view of the treeless shore zone on "the Labrador." Note the houses high up the slopes.

FIG. 3—View from the bridge of the S.S. *Acadia*, taken in July, showing floe ice and patches of snow on Labrador hills.

FIG. 4—Low islands on the Labrador coast surrounded by ice floes in July. The shores assume many fantastic and astonishing shapes under the influence of the mirage.

One of these was measured by the writer. The figures are: length, 59 feet, butt dimensions, 1 foot 4 inches by 9 inches; dimensions at small end, 9½ by 6½ inches. This piece of timber, which was cut near the head of the lake, is considerably larger than any timber near the seashore.

Black spruce (*Picea mariana*) is the dominant tree throughout the Lake Melville district (Fig. 5), but white spruce becomes increasingly common as one proceeds inland. The white birch (*Betula pendula*) is a very common tree, and in tracts which have been burned over it has taken possession of the ground to the exclusion of all other trees. The largest specimens of the birch observed, however, were seen where they occurred sparingly in forests of black and white spruce.

Where the birch constitutes the whole of the forest, as it often does over tracts which have been burned, its light green foliage distinguishes it at considerable distances from the darker evergreen forests. The forest color effects vary greatly with the illumination and the distance from the observer. Under a gray sky the black spruce forests are nearly black in the middle distance, dark green in the foreground, shading off into deep dark blue in the distance. Under a half-clouded sky the forested mountain slopes are marked with blotches of dark blue on a field of light green, the color scheme changing constantly with the shifting of the clouds. Sometimes at the finish of a shower a spruce-covered island, rainbow-arched, will furnish a picture not easily forgotten. Labrador has been described as the land of rainbows; the dozen or more daily showers often experienced during the past summer seem to justify the title.

In many places in the Labrador forest the ground is mantled by a carpet of sphagnum moss into which one sinks to the knees. When this is absent caribou moss often replaces it. Where the trees are not too closely spaced the ashen gray of the caribou moss gives a color contrast to the dark green of the black spruce visible at a considerable distance. Nearly everywhere the white blossom of the Labrador tea is seen during July. As its blossoms fade the dark pink lambkill takes its place, decorating the woods with a profusion of delicate color throughout the latter part of the summer. About the first of August the half-ripe low-bush cranberries begin to show rosy cheeks above the moss, and a little later the rich dark purple bearberries and blueberries spread a feast of delicious fruit and ravishing color on the gray rocky summit of every hill and mountain. The wild currant, the crowberry, and the baked-apple are among the other refreshments which the forests set before their visitors. Alder and willow generally form the forest border along the streams. The fragrant-leaved sweet gale is also frequently seen about the margin of the forests.

The principal trees in the approximate order of their abundance in the Lake Melville district are: black spruce (*Picea mariana*, B. S. P.); white, or canoe, birch (*Betula pendula* Roth, var. ?); tamarack (*Larix laricina*, Koch); fir (*Abies balsamea*, Mill.); white spruce (*Picea canadensis*, B. S. P.); balsam poplar (*Populus balsamifera*, L.); yellow, or gray, birch (*Betula*

lutea, Michx. f.); black, or white, birch (*Betula lenta*, L.); trembling poplar, or aspen (*Populus tremuloides*, Michx.); ground juniper (*Juniperus communis*, L., var. *depressa*, Pursh.).

The fir, white spruce, and black spruce are the trees which have been used for lumber in the region. Both the white and the black spruce reach a large size in many localities. The following figures indicate the character of some of the larger trees in these Labrador forests. On Mulligan River a black spruce measured 5 feet 6 inches in circumference 20 inches above the ground. Another black spruce on the Kenemich River measured 9 feet 10

FIG. 5—Black spruce forest near the eastern end of Lake Melville, Labrador. Much larger timber is found farther from the seacoast.

inches in circumference: its fine straight trunk appeared to be 100 feet high. The black spruce here probably reaches a greater average size than in Nova Scotia. At the head of Grand Lake a spruce in the driftwood had a diameter of 25 inches. A white birch on the Kenemich measured 5 feet 1 inch in circumference. These figures represent a few of the largest trees seen, but many others nearly or quite as large were observed. A large proportion of the forest trees approach these figures closely enough to furnish a large supply of logs suitable for lumber. The mountain slopes carry vast quantities of smaller timber which will no doubt be used eventually for pulpwood.

Two large sawmills were started in the district several years ago. One of these is near the mouth of the Grand River; the other is at Carter's Basin. They have not been in operation during recent years, but this is not from any lack of good timber. At present only one small mill, with portable gasoline engine, is in operation (Fig. 8); it furnishes lumber for local use.

It may be noted here that this region is nearer the British and European market than is any part of the Maritime Provinces.

The shores of Lake Melville are bordered by a considerable area of relatively flat or slightly rolling land on which the best timber is found. This area extends up the Grand River to Muskrat Falls, 25 miles above the mouth, and beyond (Fig. 6). On the mountain slopes much smaller trees occur.

Grand Lake, which lies northwest of Lake Melville and empties its waters into it, is without any lowland border, the mountains descending precipitously on the west and by gentle slopes on the east. This lake, which is about 30 miles long, was traversed in rainy weather when the forest-clad hills appeared and disappeared like huge gray ghosts through the foglike canopy which hung over the lake. At Cape Blanc, which is a steep-sided mountain rising abruptly from the lake, the scars of old avalanches are plainly visible. In some of these the timber and soil have both been stripped completely from the mountain face. In others in the midst of a black spruce forest, a belt of birch bounded sharply by perfectly straight lines tells the story of an old avalanche.

On the Nascaupee River and the Red River the broad sand-and-clay terraces support a better forest growth than the Grand Lake basin. My own observations in this valley extended up to its junction with the Red River and a day's journey up the Red. Mrs. Leonidas Hubbard, who traversed the entire length of the Nascaupee, reports one of the trees seen to have a circumference of nine feet. She states that "the valley is mostly well wooded with spruce and balsam as far as Mabelle Island, and here the spruce reaches splendid size."[1]

Bryant and Turner have explored parts of the region south of the Lake Melville basin which my expedition did not enter. The rivers traversed by them enter the Gulf of St. Lawrence between the Mingan Islands and the Strait of Belle Isle. Townsend writes of the timber along the Natashquan valley, nearly opposite the eastern end of Anticosti, as follows.

> The forest trees gradually increase in size from the coast where in places, as on the plateau back of the little village of Natashquan, they are nearly prostrate, to this point where they appear to have reached about their maximum and attain a height of 50 or 60 feet. Black spruce and balsam fir are the predominating trees, but white spruce are not uncommon. White birches are scattered here and there and often form pale green patches in a sea of dark spruces and show where a fire has swept through. Mountain ashes are few and far between as well as aspens, but, on the borders of the river, alders and dwarf willows are common. Of larches only a few remnants are left of this once abundant tree. Some years ago a devastating worm—the larva of a sawfly—swept through the country, and the larches were nearly exterminated. At Rigolette on Hamilton Inlet I had seen in 1906 the larches covered with these worms. Fortunately in this region of the Natashquan, at least, there are enough scattered veteran larches left to perpetuate the race, and vigorous seedlings are growing up, and I saw nothing of the worm.
>
> The largest balsam fir I measured at this place close to the 5th Falls was 64 inches in circumference three feet from the ground. A black spruce was 43 inches, a white birch

[1] *Bull. Amer. Geogr. Soc.*, Vol. 38, 1906, p. 533.

was 72 inches. The white birches are rough and lichen-stained—gray and green and black—and the bark peels off in great rolls and hangs all over the trunk in rags.[2]

The observation of Townsend that the trees on the Gulf coast can survive only as prostrate dwarfs corresponds with the conditions which may be observed further east and north.

The St. Augustine River, which enters the Gulf of St. Lawrence 150 miles east of the Natashquan River, was ascended to the Height of Land in 1912 by Henry G. Bryant. Concerning the forests observed on this expedition Bryant writes as follows.

FIG. 6—View looking down Grand River from Muskrat Falls.

Referring to the timber resources of the region traversed, it may be of interest to mention that for the first twenty-five miles above the mouth the hills rising from the broad valley of the river are covered with a thick mantle of firs and spruces of small size and growing in the close formation so characteristic of the Laurentide landscape. These growths of the lower valley are suitable for pulp manufacture but, aside from this, possess little commercial value. For the next twenty-five miles to the vicinity of the first falls the size of the two varieties mentioned improves, and many scattered groves of birches are observed. Beyond this for about twenty miles a noticeable increase in size and quality of the spruces is apparent, while the firs have become a less important element in the forestation. While the best timber is not continuous here, many tracts may be seen containing trees which measure, three feet from the ground, something over two feet in diameter. . . .

In the neighborhood of the Height of Land the country is more open, while the tops of the ridges are often quite bare. Some of the finest spruce timber encountered on the journey was found in small groves in sheltered localities within a few miles of the lake sources of the river.[3]

[2] C. W. Townsend: A Short Trip into the Labrador Peninsula by Way of the Natashquan River, *Bull. Geogr. Soc. of Philadelphia*, Vol. 11, 1913, pp. 170–182; reference on p. 175.

[3] H. G. Bryant: An Exploration in Southeastern Labrador, *Bull. Geogr. Soc. of Philadelphia*, Vol. 11, 1913, pp. 1–15; reference on pp. 13–14.

The Labrador and Alaska peninsulas on opposite sides of the continent are nearly equal in size and are in some degree comparable in the distribution of their forests. A large part of the Labrador shore line, like that of Alaska, is barren of forests. In both peninsulas the barren zone is widest along the northern shore line. In Alaska the barren shores of Seward Peninsula are replaced along the coast to the southeast by the heavy forests of southeastern Alaska and British Columbia. The wide barren zone of northern

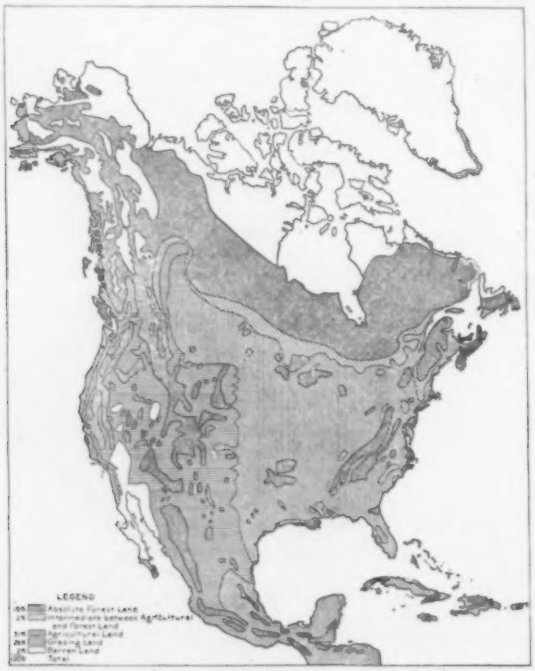

FIG. 7—Probable future land classification of North America. (After Raphael Zon with modifications in eastern Labrador by E. M. Kindle.)

Labrador and the relatively narrow barren zone of eastern and southeastern Labrador give way in like manner toward the southwest to the spruce forests of the St. Lawrence River.

Examination of the accompanying map of the distribution of North American forests will show the very important rôle which Labrador will probably play in supplying forest products for the world market of the future. The Lake Melville waterways are of peculiar importance in this connection because they afford about 200 miles of navigable waters which are usable by seagoing vessels. These waterways include Lake Melville, Grand Lake, Double Mare, and Back Way. This penetration of the heart

FIG. 8

FIG. 9

FIG. 8—Sawmill on English River, Lake Melville.
FIG. 9—Indian canoe factory in the forest at Northwest River.

of the best of the Labrador forests by deep waterways must become an important element in keeping transportation costs at a low figure.

Canada is destined by its geological and geographical features to remain permanently the great forest country of North America. Compared with the area of the great forest belt extending from the Labrador coast to the Pacific, the widely scattered forest areas to the south of it appear insignificant in size (See Fig. 7). Lake Melville may reasonably be expected to become in the future one of the important eastern outlets for the forest products of the eastern portion of this vast forest zone.

Forest By-Products

The forests of the Lake Melville region remain practically untouched. Lumber and other ordinary forest products, except as already noted, are not

Fig. 10—Eskimo family near the western end of Hamilton Inlet. The sparse forest seen at the left represents the dwarfed type of spruce commonly found near the eastern seaward limit of the forested zone.

at present produced in the Lake Melville region. The single portable mill now in operation supplies lumber only for local use, and much of this is still cut with the old hand whipsaws. Until the boundary question is settled and it is known whether Newfoundland or Canada has authority to grant timber concessions, it is not likely that any large attempt at timber or pulpwood production will be undertaken.

At present the forests supply only by-products in the shape of fur-bearing animals. In one sense the annual fur catch may be regarded as a forest by-product. The heavy forests produce what is said to be the finest grade of fur known in the north. The fur-bearing animals and the people of the region are both, strictly speaking, forest products since neither could exist in the region without the forests.

Minks, weasels, and martens are the more common fur-producing animals. Red, cross, silver, and white foxes are trapped—the last generally being found only near the coast. The otter, lynx, and beaver are also present.

This region is near the southern limit of the range of the polar bear, which is sometimes taken on the seacoast; but it, like the seal, belongs to the sea rather than to the forests.

Originally the region was divided between the Indian and the Eskimo. The latter is nearly extinct in the Hamilton Inlet region and southward. The Eskimo held the narrow seacoast strip—approximately the same narrow shore zone now occupied by the Newfoundland fisherman—while all the vast interior river and lake region belonged to the Indian. When either race overstepped the time-hallowed boundary between them, savage reprisals resulted. Battle Harbour is one of the names which has survived from the days when the Indian and Eskimo tried to revise the Labrador boundary with the tomahawk and the spear. From the region south of Hamilton Inlet the Eskimo has disappeared, and the Newfoundland

FIG. 11—Indians preparing evening meal at Northwest River.

fisherman has taken his place. The Indian still survives but lives as his ancestors did, except that canvas canoes and tents have supplanted the birch-bark canoe and the skin-covered tepee.

EVOLUTION OF THE "LIVEYERES"

In Labrador, as elsewhere on the northern frontier, natural selection is producing a type of man well adapted to a changing environment. This new type will in time supplant the Indian.

In a country where elemental conditions prevail as they do in Labrador natural selection is not an academic term but a stern reality. Nature undertakes to make of every man who claims a home in Labrador either a hunter or a fisherman. For the failures starvation waits just round the corner. The man who is a product of an environment where these two arts are not important or essential must, when he comes to Labrador, speedily acquire them unless he is able to maintain his connections with his old environment and its resources. Failure to do so means elimination by starvation. The tragic death of Leonidas Hubbard illustrates the remorseless way in which

this fundamental law works in this region. The operation of this relentless law is likewise seen in the case of the Indian when, every few years, the caribou is scarce or the fishing poor. For the Indian persistently refuses to learn the lesson of making provision for the future although his ancestors have experienced the famine demonstration hundreds of times.

The hardy French and English fishermen who came into the region a century and a half ago found it to their liking as did the agents of the Hudson's Bay Company who followed them. They and their successors have left as descendants a brown-skinned race of Indian or Eskimo extraction on the maternal side. These are the "Liveyeres," as they are called to distinguish them from the Newfoundland fishermen who do not "live here" but come and go with each fishing season. Unlike the Indian (Figs. 9 and 11) who is willing to starve but not to work when game is scarce or the caribou fails, the Liveyere is apt to have the industrious habits of his paternal ancestry. Many of them have comfortable cabins always well stocked with rifles and supplied sometimes with a few books and in one instance which I recall with a small organ. Throughout the summer they devote themselves to the salmon and trout fishing in Lake Melville and in winter to trapping. These brown-skinned sons of the forest are apparently oblivious to the existence of the insect pests. A man new to the country frequently finds his eyes swollen almost to blindness for the first three or four days, but the swelling passes away after a few days, and the initiate is then, as regards swollen features, more or less immune for the remainder of the season. I can claim a fairly intimate acquaintance with mosquitoes of both the Yukon and Mackenzie valleys but am prepared to take off my hat to the quiet efficiency of the Labrador black fly.

It is reported that the failure of one of the sawmills was due in part to the refusal of a shipload of laborers imported from Europe to labor after their arrival in the land of the black fly. It does not require much imagination on the part of anyone having a speaking acquaintance with this little insect to guess why these foreigners developed an intense longing for their homeland shortly after their arrival in Labrador. If the management of this mill had relied more on the French Canadian timber cruiser and lumberjack and the Liveyere, there might have been a different sequel to record concerning the venture.

The black flies and mosquitoes, on which my cook exhausted a new set of adjectives every day, were treated merely with silent contempt by my native guide. He never deigned to use either head net, tar dope, or adjectives against the flies which the deep-sea cook declared to be immeasurably more disturbing to his peace and happiness than any of the shipwrecks which had fallen to his lot in happier days. The Labrador native is in many cases a fine type of man, patient beyond belief, not only with the black fly but with the 60 per cent import duty assessed by Newfoundland on all of his food and clothing not taken from the forest or the sea. At the approach of winter he goes into the forest for the trapping season, sometimes with a companion

or with dogs, but frequently entirely alone and from 50 to 200 miles from any settlement. The solitary trapper ordinarily knows no other companionship for three or four months than that of the trees, the stars, and the aurora. If the trap line is a long one, four o'clock in the morning will find a good trapper on the trail. These men appear to be as perfectly adjusted to and satisfied with their environment as the foxes and the otters whose pelts they seek.

A MAP OF THE DISTRIBUTION OF POPULATION IN SWEDEN: METHOD OF PREPARATION AND GENERAL RESULTS*

By Sten De Geer

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Even today geography, in common with history and the biological sciences and ethnography, tends not infrequently to emphasize the unusual, the scientifically or popularly remarkable, at the expense of the usual—of that which is typical of nature, normal for cultural development, and of practical importance.

Need of Quantitative Data

Explanation lies partially in the lack of *quantitative* data whereby investigators in their several fields would be in position to discriminate and to give due weight to principal as distinguished from subordinate phenomena. It is a condition that modern research aims to rectify, yet even among present-day scientists the importance of quantitative investigation is far from being recognized. This attitude arises in part from a still general inconclusiveness of treatment; the method of "averages" ought to be regarded with skepticism. What is needed in any field of investigation is a sufficiently full collection of figures susceptible of graphic representation in such a manner that not only averages but enlightening and interesting details may be brought out in their proper quantitative relationships.

Not least is this true of geography. So far it is only in isolated instances that geography has developed suitable methods of expressing graphically on maps such collections of facts as will permit the drawing of general conclusions. The old descriptive geography seldom based its pronouncements on a sure quantitative basis; nor indeed does the new genetic geography which extends its view backwards toward the causes and forwards toward the effects of the facts treated. It appears to be different, however, with the new descriptive geography; and we may hope, so far as source material permits, that it may develop into a genetic-quantitative geography, charting in a clear way its detailed results with regard to chronological as well as spacial relations.

The possibilities of quantitative representation of geographical data are illustrated by the cartographical method described below. It would seem to be applicable not only in the case of distribution of individual objects—

* Karta över befolkningens fördelning i Sverige den 1 januari 1917. Med statsbidrag utgiven av Sten De Geer. 1 : 500,000. 12 plates in atlas, 22½ x 16 inches. Stockholm, [1919] (see note in the *Geogr. Rev.*, Vol. 9. 1920, p. 360). The atlas is accompanied by an explanatory text of 296 pages from which the following article has been prepared.

human beings, dwelling houses, domestic animals—or mass quantities—kinds of land, timber content of forests, economic production—but even in matters of physical geography. The method which is applied to the study of population distribution in Sweden will now be described.

Population Maps

On maps in general, population distribution is represented indirectly and usually very imperfectly by symbols showing the position and size of cities and towns and perhaps smaller centers. Maps showing relative density of population by shading or coloring give a graphic idea of population distribution as a whole provided that the strength of the tint is made directly proportional to the density of population, a desideratum seldom achieved. Furthermore, as a rule such maps show only the average over large areas, such maybe as county divisions or parishes. Details and the actual grouping of the population can be shown only by absolute methods. These methods, however, have been little used for the reason that they have employed different and often arbitrarily chosen symbols and thus are not readily intelligible.

There are four possibilities of symbolism: dots, lines, surface forms, and representation in the solid. In the mapping of relative density the first three methods have been put into use; but the fourth, the three-dimensional representation, has hitherto been neglected and has remained untried. It has been used by the author in his development of the dot method.

Development of the Dot Method: Theory

The *dot method*, as now developed and applied to the map of population distribution in Sweden, offers the possibility of combining a clear representation of situation and mass of population within quite wide limits. The dot method, of which several variants have been worked out, originated in the author's researches on the settlement of Gottland which began in the year 1906 with an unpublished map of the density of habitations on the island calculated by squares of four square kilometers dimension. By this method of procedure the map picture took no cognizance of the run of the parish boundaries. Division of the parishes into small parts proved to be necessary in order that the most characteristic differences in density might appear. Although the contours were angular and lacking in fullness of detail, the map showed clearly the four most important desert zones and several other features of interest.

It would have been easy to make new trials with ever decreasing squares in order to smooth the boundary lines and achieve detail, but the idea was at once carried to its logical conclusion with evolution of the following principle. The *squares ought to be made infinitely small.* They then become mathematical points; and representation is freed from the fallaciousness inevitable in any average calculation. In other words *absolute* method is

substituted for *relative* method. According to this, habitations should be represented on the map as small dots, one for each house, properly located.

It proved impossible, however, to make such a map of Gottland with the help of existing maps, since even the topographic sheets of the Swedish General Staff map (scale 1 : 100,000) do not give the entire number of houses especially in the more densely populated places. On the other hand information as to the total number of persons in the various parishes is readily accessible in the publications of the Statistiska Centralbyrån, Stockholm. Hence it was decided to use the number of persons in the parish as the quantitative element, the location of dwellings on the map determining the geographical position of the quantity, i.e. its more detailed distribution within the parish. From such sources there was constructed in 1908 a dot map of the distribution of population in Gottland.[1]

Distribution by Persons Versus Distribution by Habitations

As a factor contributing towards the geographical landscape, habitations are unquestionably more important than inhabitants; though, on the other hand, inhabitants mean more economically and are significant as active agents, changing the aspect of the landscape including the habitations. But both habitations and inhabitants are closely related genetically and practically; so that, considered in the large, the two factors tend to show the same distributory relation.

As has been said above, the simplest and most correct principle for construction of a house map or a population map is one dot for one object—for one house or one person. People, however, are mobile, and in the most refined analysis this should be taken into consideration; that is the number of persons for a given place should be multiplied by the percentage of time they spend in that place. The relation expressed might have reference to seasonal change—person-months; thus might be depicted the reindeer-keeping nomads, peoples practicing transhumance, summer migration of the city population, movement of fisher folk. Or the relation might be person-hours, having reference to daily movement, as in the case of large cities where the population flows in and out to and from the central working district. Inclusion of the time element, however, is limited by lack of statistical data.

Choice and Size of Dot Units

If the scale of the map is small it may be desirable or indeed necessary to let every dot indicate two or more objects. The essence of the method, however, is that *all the dots are of the same size and value*, that is to say they constitute units of a fixed quantitative value. In the map of Gottland (1908) on the scale 1 : 300,000 each dot represented 10 persons, a relation that may be most briefly expressed by saying that the *ten dot* is used. In

[1] *Ymer*, 1908, p. 240 and chart 4 facing p. 252.

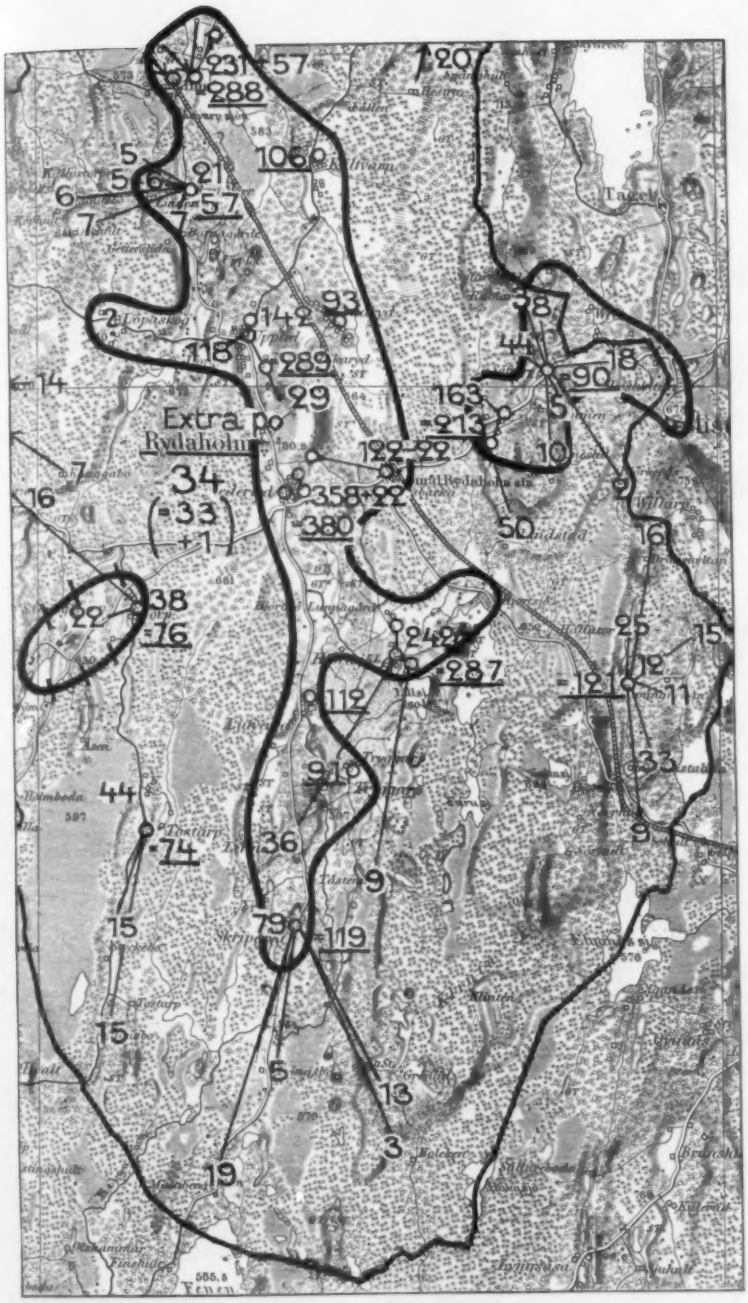

FIG. 1—Rydsholm parish in Småland, southern Sweden, showing how the inhabitants are localized on a map on the scale of 1 : 100,000 and how the numbers are added up to hundreds for representation by dots. The most extensively cultivated parts of the parish are inclosed with a heavy black line.

1914 the author published a map of the world [2] on the mean scale 1 : 80,000,000 with unit dot for 1,000,000 inhabitants; whence it may be seen that dot charts are in no wise restricted to large scales or low dot values.

In addition to the question of scale the choice of dot value depends on the nature of the distribution and its density within the area in question and on the purposes for which the map is destined. The dots should be larger on wall maps and smaller in proportion as the map is to be viewed at closer range and in harmony with other features of the drawing, thickness of lines, and amount of detail.

The individual dot on the dot map should preferably be drawn on the ratio between the natural size of the object and the fraction of the map scale. On the smaller map scales, however, one must be satisfied with having the dots enlarged symbols of the object represented. For comparison between different maps it would be an advantage if the amount of this enlargement could be fixed, either in terms of the actual size of the object in relation to the map scale or to a uniform measure expressed in millimeters or square millimeters. In 1908 the latter method was suggested by the author as it would more easily lead to uniformity. Thus the red unit dots for Gottland were given a diameter of exactly 1 millimeter, corresponding to a surface of 0.79 square millimeter, instead of a surface of 1 square millimeter and a diameter of 1.13 millimeters. The only large city here is Visby, and this was represented by a rectangular symbol measured in even millimeters.

Use of Three-Dimensional Symbols: The Sphere

The problem with reference to the population map of the whole of Sweden proved, however, to be very different since the cities here were to be drawn as large spheres side by side with the unit dots. It was found best then to calculate on a basis of unit volume, the unit dots representing the unit of volume. The most suitable unit proved to be the cubic millimeter with radius of 0.57 millimeter and dot diameter of 1.15 millimeters.

The unit dots are considered as small spheres and ought to be shaded as such to produce the right volume impression, i.e. mass effect, in relation to the variously sized spheres representing the larger cities. Practically, however, this is difficult of achievement. A possibility would be to use a circle filled in with solid color save for a round white dot in the northwest quadrant, but the expense involved in this case has made impracticable any such application of the three-dimensional method of illustration. The unit spheres have been colored solidly (black), and they must be pictured as globes by an effort of the imagination. This modification of symbolism, however, carries with it one advantage, namely, that the unit dots stand out more prominently, in fact as prominently as possible in respect of their size. Viewed from a distance this is a particular advantage, and it is indeed

[2] Sten De Geer: Oceanernas trafiklinjer, Medd. från Handelskammaren i Karlstad, 1914.

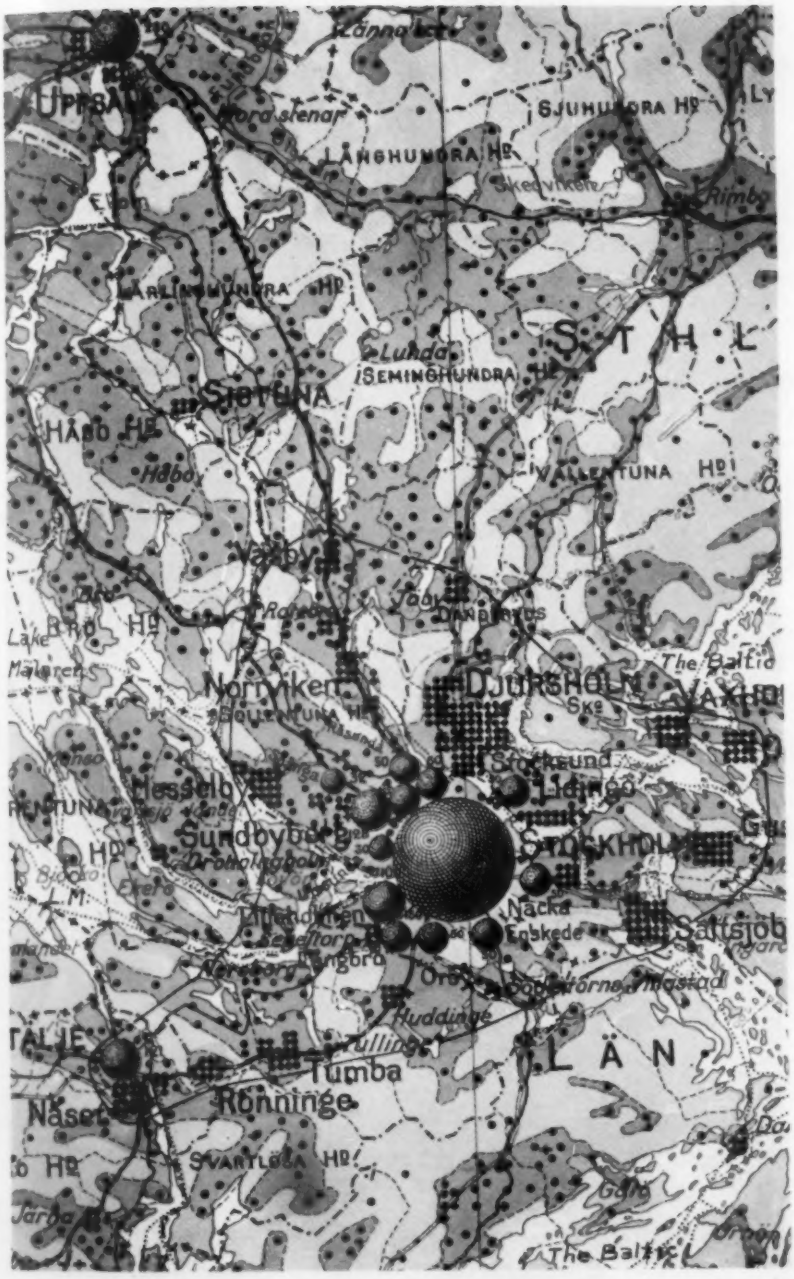

FIG. 2—Stockholm and district from the population map of Sweden, scale 1 : 500,000. Each dot represents 100 persons. The figures by the spheres indicate the number of dots comprised therein. On the original map cultivated areas are shown in yellow (here the darker shade of grey); communications, administrative boundaries; and names in red (here black); water in blue. A thin black line defines the area of the suburbs of Stockholm. The large sphere represents 371,000 inhabitants, the 13 suburban spheres 85,600, and the 30 dot nets 30,400 inhabitants, making a total of 487,000 (in 1917) as the population of Greater Stockholm.

a question whether the practical gain as a whole does not to a considerable extent overbalance the theoretical loss.

It is an indispensable requirement that any population map, as any other cartographical expression of mass or density, should be clear and unequivocal, that is that there should be strictly proportional grading of symbols in respect of magnitude or strength of color or the product of magnitude and color strength.

For the population map of Sweden an absolute method was used in which mass was represented not by color strength but only by size. The dot method used for the map of Gottland was developed to include the larger cities by spheres and spherical shading. Under this plan the greater part of the population has been depicted by means of 100-unit spheres which, however, for technical reasons already mentioned have not been shaded, the shading being confined to the spheres representing the larger cities. The 100-unit dots indicate villages, fishing places, industrial centers, and trade centers and cities proper of not more than 5,000 inhabitants. Unit dots in fact have been used wherever space permitted on account of their greater degree of clearness and of the ease with which the number of inhabitants could be determined by counting the dots, which latter is an easier operation than the computation necessary in the case of the spheres.

Arrangement of Dots

By this means larger and smaller groups, sometimes with as many as 50 dots, have come to indicate a certain densely populated place, or a townlike community, while other groups of dots indicate villages or other agricultural settlements. For this reason the author has further elaborated his method evolved in 1908 by the arrangement of dots into squares, rectangles, or other figures closely corresponding with the actual surficial extent of the settlement. By regularly arranged rows of dots the densely populated places of urban character are distinguished from the irregularly massed dots of the rural communities. Undoubtedly inconsistencies and perhaps even mistakes occur in the working out of this distinction, but it is admittedly a gain to the interpretative quality of the map.

The Dot Net

A row of regularly arranged dots comprises dots of 1.15 millimeters diameter separated by spaces of 0.1 millimeter; thus four dots in a row occupy a space of 4.90 millimeters, or practically 5 millimeters, and this has served as a standard and control in the drawing of what may be termed the *dot net*. On the population map of Sweden the regular groups of dots are built up along east-and-west or north-and-south lines, a contrast in this respect with the Gottland map whereon they were orientated according to the longitudinal axis of the community. The orientated dot nets make the difference between agricultural and industrial population stand out clearly.

Limits of Use of Dot Net

Construction of the population map includes among its tenets that "a dot shall fall entirely within its own parish." But it is evident that the dot net which calls for an unduly large area may fall partially over bordering parishes. When this disadvantage becomes too great, that is in general about the limit of 5,000 inhabitants, the larger spheres are used instead. Thus the Stockholm sphere has a radius of 8.9 millimeters corresponding to 371,000 inhabitants, while a circle of the area of the unit dots would have a radius of 34.4 millimeters, and similarly a dot net of 3,710 dots would cover a square of 75 millimeters side. As has been pointed out, the quantitative value of the spheres is not so readily estimated; hence, to facilitate comparison, the value of the sphere expressed in units is indicated by figures placed within or by the side of the sphere; thus by the sphere for Stockholm is the figure 3,710.

As was said above, the upper limit for the use of the dot net is round about 5,000 inhabitants. Some regional trade centers with a somewhat smaller population have, however, been given the sphere symbol; while, on the other hand, a few mining and industrial centers with a larger number of inhabitants have been shown by dot nets for the sake of consistency. The lower limit for use of the dot net may be thought of as about 1,000 inhabitants, a figure the author arrived at some years ago as a reasonable lower limit of urban settlement in the Scandinavian countries. Work on the dot map, however, has shown that this limit cannot be maintained in the representation of population density. To be sure, the urban character of places disappears at about this value or perhaps even above it; but a smaller agglomeration may yet be sufficiently densely populated and, unlike the agricultural village, may function without direct dependence on the immediate surroundings so that it is desirable to distinguish it from the ordinary rural community. The lower limit of the dot net must therefore be set at a lower figure—four dots, sometimes even two dots or a single dot, may be regarded as representing characteristics pertaining to the dot net. Dot nets of three or four dots, i.e. 300 to 400 inhabitants, may be clearly distinguished on the map from agrarian population groups, and furthermore they are usually identified by name.

The Dot Method in Practice

While the theory of construction of the dot map is simple, the actual working out is relatively complicated. Surprisingly little can be done mechanically even when one is equipped with adequate data of numerical and spacial relations.

Processes of Construction

Whether the basis of distribution is made from the number of dwellings counted on the map or the number of inhabitants according to census

statistics, the work involves two processes. First comes a trial gathering of the smaller settlements into groups of 100 inhabitants or the number of farms corresponding to that amount; while, on the other hand, the larger settlements, towns and cities, are divided up into parts corresponding with the number of dot units (total numerical vaiues being rounded off to even hundreds). The second process is the careful determination of the position of the dots on the map, whether dot nets or single dots.

In the case of the dot nets the choice lies between a possible square arrangement or a form accordant with the areal extent of the place or the available space on the map.

Rules for Placing Dots

Three rules have been drawn up for guidance in the placing of single dots representing groups of isolated houses or small hamlets. First, the dot should be set directly over that place which has more than 50 inhabitants, i.e. more than half the total number represented. Secondly, it should be placed near the center of gravity for the group as such. Thirdly, its position should be determined with due regard to circumstances of density and position of the neighboring groups and indeed to the distribution in the parish as a whole. Near parish boundaries consideration must also be given to dots of the bordering parishes. Thus, for instance, two adjacent border villages of 50 inhabitants should not be represented by two dots but by a single dot. If a dominating settlement is lacking, then the position of the largest existing habitation is to be taken as the position for the dot; but the smaller it is, the more regard must be paid to centralizing the position in relation to the other habitations of the group. As may easily be seen, the three rules are at constant variance with one another; in compromising between them geographical judgment must be brought to bear upon the problem, and hence no fixed rules can be laid down.

In choosing positions for the dots the novice strives more or less unconsciously for an even spacing in an effort to balance mistakes in grouping. But when one becomes accustomed to the work or is in possession of a fuller collection of facts or has a greater knowledge of the character of the region in question, one is particularly on the lookout to depict the actually existing contrasts, aggregations of dots as well as wide empty spaces. Only exceptionally and after long familiarity can the most telling picture of the distribution of population in a large parish be secured without rearrangement and often complete redistribution for the entire parish.

Experience has shown that geographical judgment and care have in fact greater influence upon the correctness of the dot picture than differences between the methods of procedure in the proportioning of the dots.

Habitation Density in Relation to Character of Settlement

The distribution of population which has been represented by means of dots and large spheres constitutes the most important geographical feature

of the map, the further content of which has been selected with regard to its causal connection with the population factor. Most closely connected with population distribution is the distribution of improved land, the two factors making reciprocal demands upon each other.

Areas of dense habitation in general represent the cultivated and settled country. Experience with the population map has shown that the settled country can largely be defined by generalization of the facts presented by the dots. This has been confirmed as a result of two different and for the most part independent investigations, one of the population and the other of the extension of improved land.

Map of Relative Population Density

The problem of representing the various degrees of habitation density may seem identical with the task of constructing a map of relative population density (free from the limitations imposed by administrative and other artificial boundaries) on the basis of the absolute dot map. Heretofore, for lack of formulated method in treating a sufficiently large collection of data in a manner at once thorough and detailed, the selection of grades of population density has either been arbitrary or has been based on too generalized criteria, with consequent sacrifice of actually existing and typical variations to averages and thus to the detriment of the geographical quality of the map.

There are two kinds of objective method for the determination of relative density on an absolute dot map. Curves showing dot density may be interpolated mathematically between the dots, or else by taking into consideration geographical, natural, or cultural boundaries one may endeavor to draw rational limits of dot density. Both methods have been tested, and both in fact have been used on the population map.

Heretofore it has been the practice to distinguish a large number of grades of population density. Through detailed study of the actual grouping of population this has been proved untenable. In respect of the population density of Sweden, at most five grades of density can be recognized: uninhabited country; scattered settlement, thin settlement, dense settlement, urban settlement. In general, however, the scattered and thin settlement may be thought of as consisting entirely of small densely settled spots scattered over wide stretches of uninhabited land. The three essential degrees of density in this case would be: uninhabited land, dense settlement, urban settlement.

On the population map of Sweden the area of connected dense settlement has been shown by deep yellow color: this together with the black dots outside of it should be regarded as *inhabited Sweden*. It constitutes a complex system of largely cultivated surface with a population density of from 50 to 100 inhabitants per square kilometer. As the forest tracts here are abstracted from the area under scattered and thin population, so the

ground under cultivation should be separated from the more densely populated areas of industrial settlement. With this, then, would disappear the difference between the apparently well delineated density grade of dense settlement and urban settlement. Inhabited Sweden would then be considered as composed of a very large number of small areas having a population density of about 1,000 people per square kilometer and having approximately the extent shown by the dots and larger spheres on the map. The entire concept of population density is to a high degree relative, being dependent upon the dimensions of the areas to which reference is made. By the refinement suggested above progress is made from thinking in relative measures ("20 inhabitants to the square kilometer") to absolute numbers ("a population density tract with 2,000 inhabitants").

It is directly apparent from the map that, as far as large tracts are concerned, agriculture in Sweden always creates greater average population density than country industry has hitherto been able to accomplish. Where under exceptional circumstances agriculture and industry have developed in the same region, as in the Malmö district, the greatest average density has arisen.

If abstraction is made of all towns and industrial centers, the density grade of rural areas even within densely settled districts does not greatly exceed between 50 and 100 people per square kilometer. Furthermore, this density is undergoing a steady decline that has been in progress since 1865; partly as a consequence of emigration, as in Vermland (north of Lake Venern) for example, and partly because of the revolutionizing of agriculture by means of modern labor-saving methods, as in Scania as a whole. Among the densely peopled regions such areas show a comparatively thin settlement.

The greatest population density among Swedish agricultural areas is in the valleys of northern Sweden, wherein upper Dalecarlia leads with a density of 200 people to the square kilometer. There the old villages remain. The valley people love their homesteads, and, though their numbers have increased and the cultivated area cannot be extended, they have preferred to stay and divide their farms. The yields per square kilometer are now the greatest in Sweden. Forestry and industry also help to counteract an otherwise imminent depopulation in these settlements.

Such is a single instance of the comparative work that may be done on the basis of the population map. It has a practical value in an infinite variety of applications: in questions of readjustment of boundaries of administrative divisions or of social organizations, of the establishment of public or private institutions, of lines of communication, of the stationing of officials, of the selling of goods, of educational propaganda, of organization of traffic in times of peace and mobilization in times of war—in short, in any matter where it is necessary to know the number and grouping of people.

The map of population distribution can and ought to be causal in the

sense of showing, as many-sidedly and clearly as possible, the connection between this distribution and the most important geographical factors which influence or have been influenced by the grouping of population, whether these be natural or the result of man's activity. Nature, as well as the life of the people, is very changeable, and the geographical factors are many. Hence a strict limitation to a few factors becomes necessary for the preservation of clearness and legibility in the map. These are the ends that have been striven for in the working out of the population map of Sweden; though such are the difficulties involved that they are far from having been attained.

THE GEOGRAPHICAL CHARACTERISTICS OF WESTERN FRANCE

By René Musset
University of Rennes

In the harmonious assemblage of regions that constitute France the individuality of the separate units is clearly recognized in the common parlance. Most highly individualized without doubt is that known as the "West." The word is vague, but its connotation is precise. The country folk know well enough where the West begins. The plains round Évreux, Chartres, Châteaudun, Vendôme, Tours, Poitiers lie on its border, but they are not of the West. Lieuvin and the *pays* of Auge, Perche, eastern Anjou, and the Vendée are included within its limits. We shall later consider in detail the significance of this limit; what concerns us immediately is the extraordinarily clear-cut nature of the boundary, a fact the more astonishing in that it corresponds to no geological or morphological boundary but without apparent reason cuts across uniform terrains. Outside the boundary regional change is marked; within one finds a prevailing uniformity only modified on approach to the sea. This uniformity is attested by physical and human characteristics alike.

The Morphological Characteristics of Western France

From the point of view of physical geography the West is a unit. It presents a slightly accidented surface without sizable plains or forms of strong relief. The greatest elevations scarcely exceed 400 meters (417 meters in Bas-Maine, 391 in Brittany, 285 in Vendée); the limited areas of level land are found for the most part in the valleys. The general aspect of the country is that of an undulating plateau.

The Border of the West: The Clay-with-Flints Peneplain

Approaching the West from the Paris Basin by way of Évreux, Chartres, or Châteaudun, for example, one rises slowly and regularly to the surface of a great plateau, almost completely level and unbroken by large valleys. It is interrupted by a sharp rise whose steep slopes mark the highest altitudes. From 120 meters it rises southward to 309 meters in the "Monts d'Amain," then sinks to 200 meters and less. In the region of Le Mans the edge of the plateau has been greatly dissected and the height is no more than 120 to 80 meters.

The plateau surface does not correspond to the outcrop of a layer of hard

rock. It is not a structural plain but an erosion surface, an old peneplain. From edge to edge it bevels in succession the tilted layers of the Upper Cretaceous, Cenomanian, Turonian, Senonian. The surface is constituted by a residual layer, clay-with-flints derived from superficial weathering of the chalk. The peneplain can be dated by the occurrence on its surface of unconformable fragments of an Eocene covering, the most ancient beds of which are Sparnacian; the clay-with-flints peneplain dates then from the end of the Cretaceous or the beginning of the Tertiary. The present inclination of this ancient peneplain is relatively great; the original slope was evidently much gentler. Examination of the present altitudes shows that it has suffered deformation by uplift which affected in particular those parts now most elevated. This uplift originally extended to the western limit of the plateau; the break of slope which bounds it corresponds to a sunken zone scarp more or less worn back in places by the ordinary processes of erosion.

The Armorican Peneplain

Let us now turn farther westward, to Bas-Maine. This is a region of primary rocks, greatly folded and showing granitic intrusions. The folds have been worn down to their base; prolonged erosion has reduced the region to a peneplain. It now presents the form of slightly accidented plateaus, clearly distinguishable on the topographic map and easily visualized as parts of a continuous plain. Here and there upon the surface appear Eocene sediments resting discordantly upon the worn primary terrain. This peneplain, as I have shown elsewhere in detail,[1] is the result of an almost complete base-leveling. It dates from the end of the Cretaceous or the beginning of the Tertiary.

It is similarly developed over the other ancient terrains of the Armorican massif—in the Norman Bocage and in Cotentin to the north, in Anjou to the south, and westward in Brittany, where M. de Martonne has proved its existence.[2] The entire area exhibits levels of the same aspect and of the same age formed under the same conditions. Over the surface throughout are scattered numerous fragments of Eocene deposits, notably in Brittany.[3]

The peneplain of Bas-Maine is only a portion of a great peneplain involving all the Armorican massif and hence known as the Armorican peneplain. On the periphery of the massif it can be traced beyond the outcrops of ancient rocks on the secondary rocks of the border, truncating their layers obliquely and in places carrying on its surface Eocene deposits. Where chalk existed whether of Cretaceous age, as in the case of the clay-with-flints peneplain, or of Jurassic age, its surface is composed of clay-with-flints.

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[1] René Musset: Le Bas-Maine, Paris, 1917.

[2] Emmanuel de Martonne: La pénéplaine et les côtes bretonnes, *Ann. de Géogr.*, Vol. 15, 1906, pp. 213–236 and 299–328.

[3] The Eocene fragments in Brittany are generally omitted from the geological map, scale 1 : 80,000.

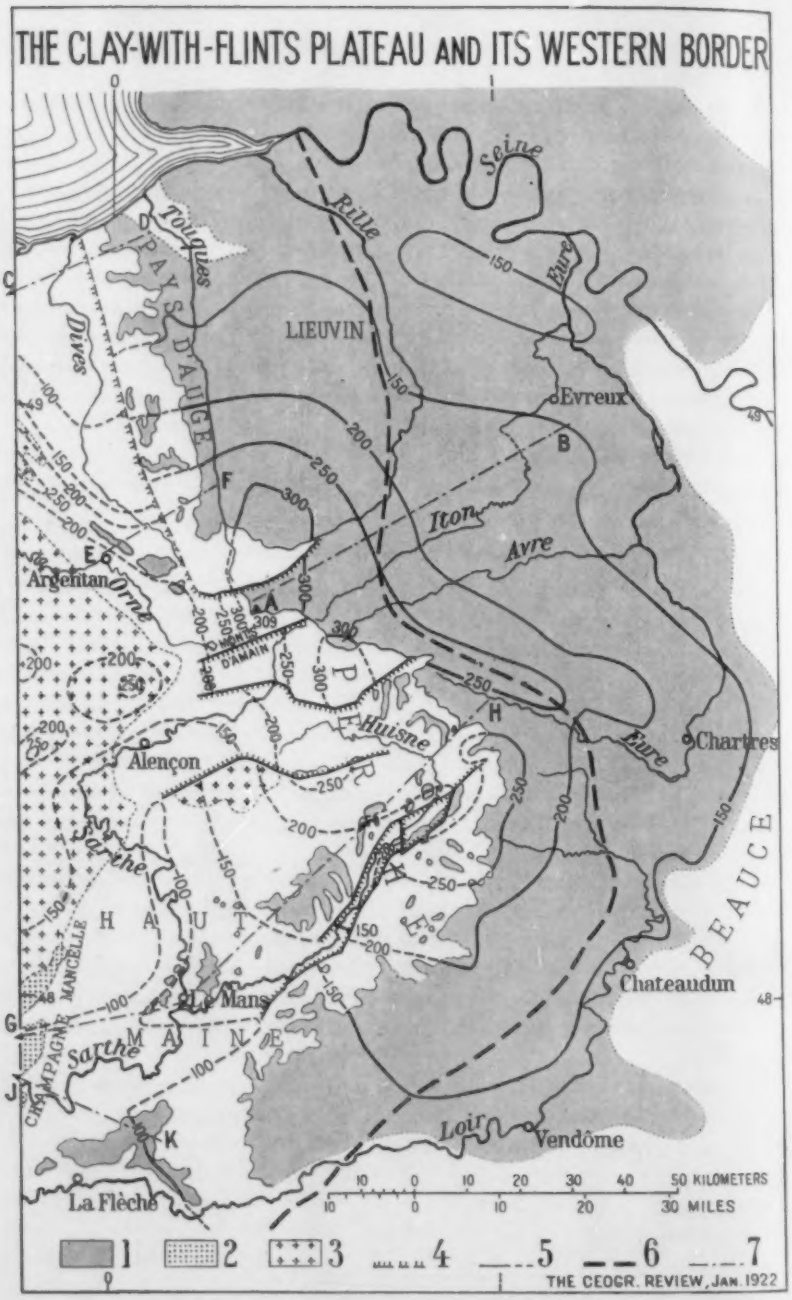

FIG. 1—The clay-with-flints plateau and its western border. Reference to numbers in key: 1, clay-with-flints on Cretaceous rocks; 2, clay-with-flints on Jurassic rocks; 3, ancient terrain of the Armorican massif; 4, faults (cross lines indicate direction of downthrow); 5, lines of sections shown in Figure 2; 6, western limit of *bocage* and the "West"; 7, contours of the peneplain of western France (figures give altitude in meters). Scale approximately 1 : 1,300,000.

Relation Between the Clay-with-Flints and the Armorican Peneplains

The clay-with-flints and the Armorican peneplains are contemporaneous. On the surface of both appears clay-with-flints, especially on the former.

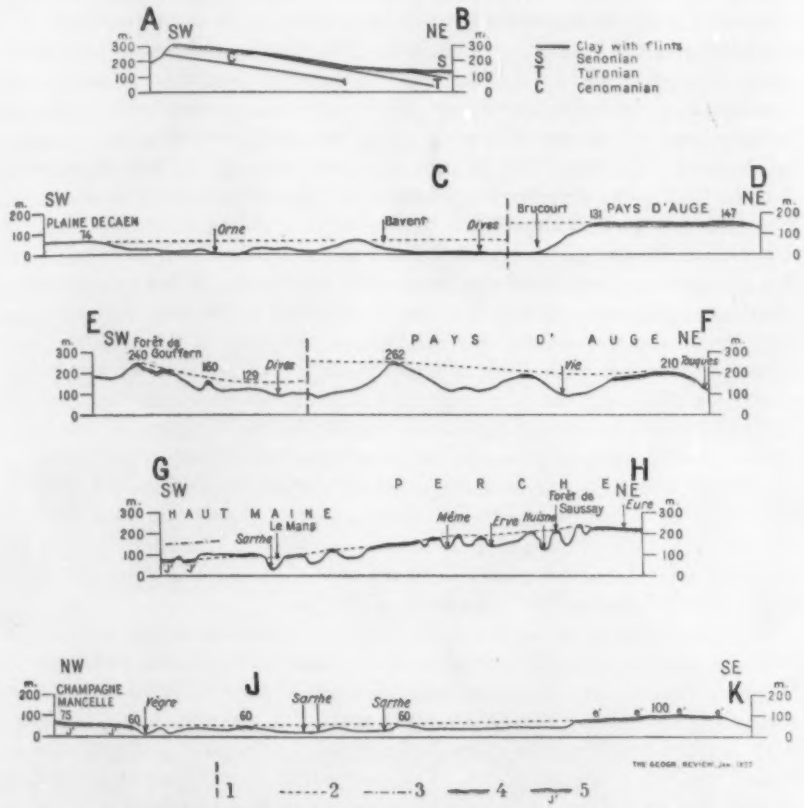

FIG. 2—Sections along lines AB, CD, EF, GH, JK of map, Figure 1. Reference to numbers in key: 1, faults; 2, peneplain of western France; 3, upper (older) peneplain; 4, clay-with-flints on Cretaceous rocks; 5, clay-with-flints on Jurassic rocks; 6, superficial Eocene deposits. The vertical scale of CD, EF, JK is ten times, of GH fifty times, the horizontal scale.

Do they not then represent two portions of a single plain? From the English Channel to the Loire they are separated by a continuous depression. It is marked by the valley of the Dives, then by the broad depressed zone of Perche and Haut-Maine, and finally by the long *couloir* which corresponds for the most part to the course of the Sarthe downstream from Le Mans. Along this depression, as we have seen, the clay-with-flints peneplain falls abruptly with a sharp break of slope; but beyond it occur little plateaus,

or hill summits, capped by clay-with-flints, evidently remains of a prolongation of the clay-with-flints peneplain, although at a lower altitude. At the same time they effect a junction with the Armorican peneplain.

The regions of Perche and Maine furnish the best illustration (map, Fig. 1, and sections, Fig. 2). The uplift which affected the region and which is still distinguishable in the part of the clay-with-flints plateau that has been preserved had for its result here in consequence of its intensification a foundering of the entire key of the arch. The Perche appears as a depressed area, cut by numerous faults, trending roughly east-west or southwest-northeast, variable in downthrow and magnitude. Between the faults are plateaus and hills crowned by clay-with-flints and Eocene fragments similar to those of the clay-with-flints peneplain but lower in altitude; they are in fact *buttes-témoins* standing at a lower altitude because they have participated in the general depression of the region. Along a section from the Upper Eure to Le Mans parallel to the Huisne the clay-with-flints peneplain has an altitude of 220 meters on the Eure, on its border it rises to 240 meters, then it only appears as *buttes-témoins* at altitudes of 220, 200, 180–160, 140, and finally 120–110 meters above Le Mans. Beyond Le Mans to the west of the Sarthe clay-with-flints of Cretaceous source are seen at 100 meters elevation. This surface is prolonged westward by clay-with-flint deposits of Jurassic source and of the same altitude in the Champagne mancelle. Now the Champagne mancelle in its turn passes without any break of continuity in Bas-Maine into the Armorican peneplain, which northeast of Laval has an elevation of 120–160 meters. The Champagne mancelle here corresponds to the lowest part of the depression. Analogous facts are observed farther north at the foot of the *côte* of the *pays* of Auge and again in the region between Le Mans and La Flèche.

It appears then that the clay-with-flints and Armorican peneplains are in fact portions of a single peneplain which we may call the peneplain of Western France, but they are separated by a zone of subsidence. This zone divides the West into two distinct parts. To the east is the clay-with-flints plateau adjoining the Paris Basin region; to the west is the Armorican massif with its marginal areas. The depression constitutes an important passageway providing a route for the chief north-to-south lines of traffic in the West. It is used by the roads and railways from Caen to Angers. At the points where these roads are crossed by east-west roads are situated a series of important towns, Caen, Alençon, Le Mans, Angers.

Deformation of the Peneplain of Western France

The peneplain of western France, dating from the end of the Mesozoic or the beginning of the Tertiary, has been deformed by subsequent movements. The topographic map makes this clear. It shows the upwarping of the great clay-with-flints plateau by an epirogenic movement which attained its maximum effect where elevations are greatest, to the south of the *pays*

of Auge and to the northwest of Perche. The zone of concomitant subsidence now occupied by the valley of the Dives, Perche, and Haut-Maine and the valley of the Sarthe has already been pointed out. Two other depressions may be distinguished with equal ease. One is along the valley of the Loire upstream to Blois, the other across Upper Brittany from the mouth of the Loire and of the Vilaine to the English Channel about St. Malo. In both occur the calcareous shelly sands known as *faluns* deposited during invasion by the Miocene sea. Both depressions are followed by roads and railways, and the Vilaine depression also by the Ille-Rance canal. Large towns are naturally situated there—Angers and Nantes in the Loire valley, Rennes in the Breton depression. Finally there is another depression which was also invaded by the Miocene sea, the *col* of Cotentin, isolating the northern part of this peninsula from the Armorican massif (Fig. 4).

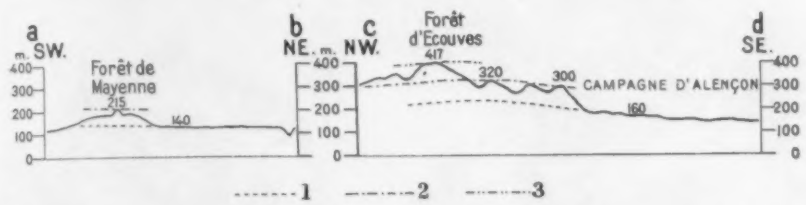

FIG. 3—Sections across Bas-Maine (ab) and the Campagne d'Alençon (cd). Reference to numbers in key: 1, peneplain of western France; 2, 3, older peneplains. The vertical scale is ten times the horizontal scale.

Between these depressed areas the inverse movement has created the more elevated areas, the north of Cotentin, the Norman Bocage, Bas-Maine, Lower Brittany,[4] Vendée, the most isolated and least accessible parts of the West.

IRREGULARITIES OF RELIEF ABOVE AND BELOW THE PENEPLAIN OF WESTERN FRANCE

In these elevated and isolated regions the peneplain of western France, though it constitutes the fundamental physical feature, does not occupy the entire surface. Above it in detached areas of more elevated relief are seen fragments of older peneplains; below are evidences of erosion at a lower level in a more recent cycle.

In Bas-Maine to the east of Mayenne rising above the major peneplain, which here has an altitude of 120–140 meters, is the narrow steep-sloped ridge of the Forêt de Mayenne, 200–215 meters in height. The level surface bevels old folded rocks. Similarly about the upper course of the Mayenne, where the major peneplain rises towards the south from 120 to 160 meters altitude, is seen another fragment of the older peneplain at an altitude of 240 meters.

[4] The terms Upper and Lower Brittany (Haute-Bretagne, Basse-Bretagne) have no reference to altitude: they originated in the relatively greater or lesser importance of the areas (the case of Haut-Maine and Bas-Maine is similar).

Above the level of this older peneplain rise narrow ridges, elongated, bounded on all sides by abrupt slopes with level summit surfaces often followed by trails. Such are the heights of the *forêts* of Multonne, Pail, Écouves, La Ferté, Andaine. They are the remains of a still more ancient peneplain now highly fragmented. These monadnocks owe their preservation to the resistant qualities of the constituent rock, Armorican sandstone

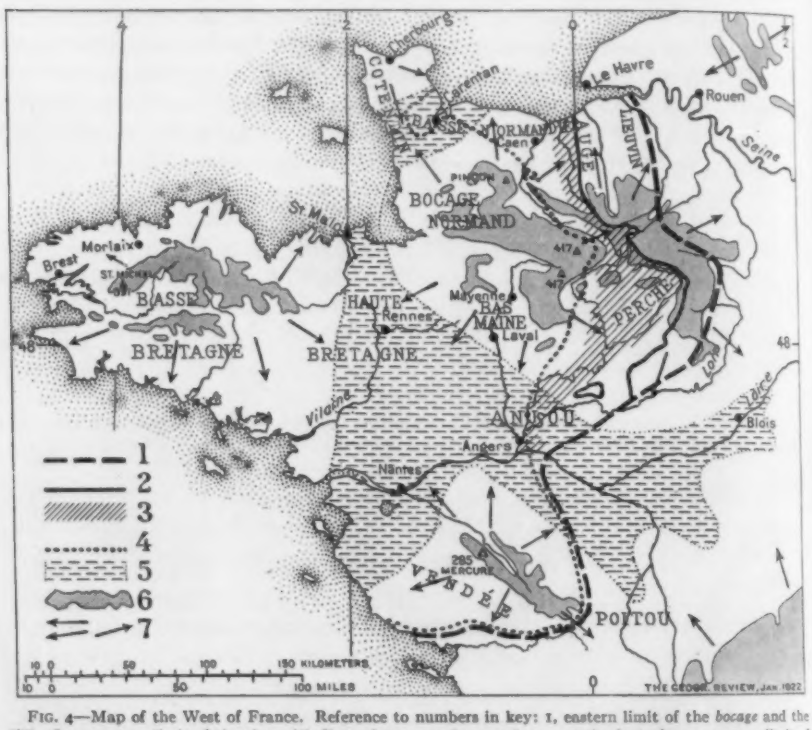

FIG. 4—Map of the West of France. Reference to numbers in key: 1, eastern limit of the *bocage* and the "West"; 2, western limit of the clay-with-flints plateau; 3, depressed zone at the foot of 2; 4, eastern limit of the ancient terrains of the Armorican massif; 5, area invaded by the *faluns* sea of Miocene times; 6, land above 200 meters altitude; 7, direction of slope of the peneplain surfaces. Scale approximately 1 : 4,400,000.

for the most part. They form the highest elevations of the West, 417 meters in the Forêt d'Écouves and the summit of the Avaloirs in the Forêt de Multonne.

Fragments of these two ancient peneplains may be distinguished in the Norman Bocage. The Mont Pinçon area offers a striking example. The major peneplain, which here rises from north to south from 100 to 200 meters, terminates abruptly against a steep slope leading to another level surface strung along the edge of which is a series of villages—Ondefontaine, Roucamp, Campandré, St. Martin; it is the lower of the two older peneplains. The higher peneplain is seen in Mont Pinçon, a flat-topped butte of

360–365 meters, an admirable observation post for the study of the facts here described. On the summit Cenomanian rocks appear, beveled by the surface of the peneplain, which is thus dated as posterior to this formation. Thus the three successive peneplanations which have left their traces in the relief of western France took place between the Cenomanian and the early Tertiary.

In Lower Brittany the three peneplains are developed about Montagne d'Arrée for example. The youngest peneplain has an altitude of 80 meters at Morlaix and rises towards the south to 140 meters where it is dominated by more elevated buttes, the fragmented remains of the older peneplain with an altitude rising from 220 to 280 meters about Plounéour-Menez.

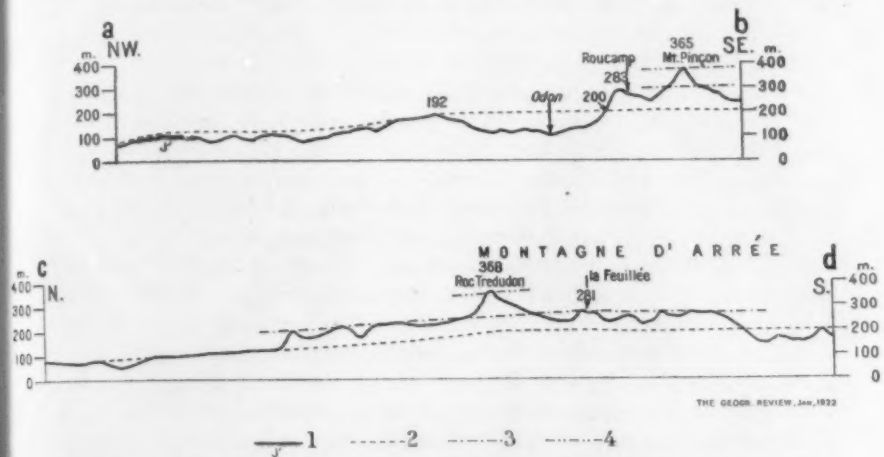

FIG. 5—Sections in the Norman Bocage (ab) and Lower Brittany (cd), the former passing through Mont Pinçon, the latter from a little south of Morlaix across the northern plateau and the Montagne d'Arrée. Reference to numbers in key: 1, clay-with-flints on Jurassic rocks; 2, peneplain of western France; 3, 4 older peneplains. Vertical scale ten times horizontal scale.

Above, a narrow ridge whose dissected summits average about 360–370 meters (391 in the isolated butte of St. Michel-de-Brasparts, the highest point of Brittany) represents the oldest peneplain. Southward the younger of the two upper peneplains has an altitude of 280 meters about La Feuillée and the marshes of St. Michel, a region of topographic senility and poorly organized drainage; whence a rapid descent leads to the youngest peneplain.

In the Vendée two peneplains can be recognized, and in some isolated summits such as Mont Mercure (285 meters) the fragmented remains of the third. In northern Cotentin, however, are only two peneplains. From the *col* of Cotentin the youngest peneplain rises from 50 to 100 meters, where it terminates in steep cliffs along the shore. Above are the heights of La Hague, 170–180 meters.

Below the level of the peneplain of western France are the young valleys and plains developed in the course of a recent cycle (or cycles) of erosion,

due to changes in relative level between land and sea. The contrast between the different parts of the West is very clear in this respect. To the east on the great clay-with-flints plateau (an impervious layer resting upon pervious chalk) valleys are not numerous, and only the principal rivers are entrenched. Some of the streams, the Avre and Iton for instance, have a tendency to lose their waters by infiltration in the underlying porous limestones; and the work of subaerial erosion is thus retarded. The peneplain, almost entirely cleaned of later Tertiary deposits, is preserved in a state of great perfection. On the impermeable surface of the Armorican massif, on the contrary, the rejuvenated streams have begun dissection of the peneplain, transforming it to a surface irregular in detail. Entrenched valleys are numerous; such are, in Bas-Maine, the Sarthe between St. Ceneri and Beaumont and the Mayenne below the confluence of the Varenne; and, in Brittany, the Vilaine below Rennes and the lower parts of all the coast streams. In every section of their course the valleys show characteristics of youth. In Lower Brittany popular speech distinguishes between the *traon*, narrow, steep-sided valleys originating in the present cycle of erosion, and the *toul*, marshy valleys of ill-organized drainage in the upper courses not yet attacked by the revived forces of erosion. In the intermediate depression, between the clay-with-flint plateau and the Armorican massif, tectonic subsidence has facilitated the work of erosion; and large valleys such as those of Dives, Huisne, and the lower Sarthe have developed. Where subsidence has been greatest, and the rocks are little resistant, enlargement of the valleys has proceeded until they are expanded into genuine plains, such as that of the Dives or the "Vallée d'Auge" or of the middle Sarthe or the *pays manceau*, this latter on friable Cenomanian sands. On the areas invaded by the Miocene sea there are also large valleys or little plains, such as the "Gulf" of Carentan in Cotentin, the valley of the Loire, and the depression known as the "Basin of Rennes."

A final episode in the morphology of the region is a series of very recent movements of coastal subsidence as result of which the erosive activity of the rivers has been diminished and the lower ends of the valleys have been invaded by the sea. Thus have been formed the Breton rias and that extreme indentation of coast line that has contributed so greatly to the encouragement of maritime pursuits and the multiplication of ports along the Breton coast. All the valleys of the western rivers have a submarine prolongation, not only those of Brittany but also, for example, those of the Loire, Vilaine, and Orne.

Human Geography of Western France

Study of the human geography of the region strengthens the impression of uniformity created by study of the morphology. It is, indeed, largely dependent on two physical facts which carry a train of consequences for human life: the impermeable soil and the humid, oceanic climate.

Impermeability of the Soil

The West shows great variety in the age and composition of its constituent rocks, crystalline and primary in the Armorican massif, secondary (Jurassic and Cretaceous) in the eastern section. The older rocks are impermeable save over limited areas of limestone and sandstone, become semi-permeable through fissuring. The younger rocks are also impermeable; clays predominate; limestones are marly or superficially covered with clay-with-flints; sands are rare. There are, however, more extensive areas of bare limestone which form little regions distinctly drier and locally known as *plaines*. Thus, though the West is varied as regards the nature and age of its rocks, it is uniform in respect of that important physical quality, their impermeability. From this springs one of the most striking features in the physiognomy of the country—its humidness, or freshness; for in addition to impermeable soil there is a rainy climate.

The Humid, Oceanic Climate

The West is strongly exposed to maritime influence by its position, well advanced into open ocean; its terminal, Brittany, is a peninsula surrounded on three sides by the sea. The dominant westerly and southwesterly winds, charged with moisture, bring abundant precipitation to the land. This fact need not be enlarged on here. A highly detailed study of the rainfall of western France has been made by M. Angot.[5] A few figures will suffice as illustration. The total annual precipitation everywhere exceeds 600–700 millimeters. Heavier rains fall on the peninsulas directly exposed to the winds. The western extremity of Brittany has 800–900 millimeters, the north of Cotentin over 800. The more elevated parts receive still heavier rains: the heights of Lower Brittany, of the Norman Bocage, and of Bas-Maine have over one meter; the rainiest stations are La Feuillée in the Montagne d'Arrée (1,181 millimeters), Edern in the Montagnes Noire (1,173 millimeters), Beauficel in the Norman Bocage (1,133 millimeters). The rains are evenly distributed throughout the year. Even in summer, when the least rainfall is registered, and at considerable distances from the sea the amount is considerable. Thus Laval, at an altitude of 60 meters, has the following monthly rainfall (average for 1851–1900):

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
61	49	50	46	54	62	55	51	53	67	66	68	682 mm.

For the region as a whole the ratio between the rainfall of the rainiest and driest months is about 3 to 2, and even in the western part it scarcely surpasses 2 to 1, low values. The essential fact, however, is not so much the rainfall as the humidity. Violent showers are rare. Precipitation is generally in the form of slow and gentle rains, which leave but little trace in the rain

[5] Alfred Angot: Études sur le climat de la France: Régime des pluies, Part I, *Ann. Bureau Central Météorol.*, 1911, Vol. 1, Paris, 1916, pp. 109–236. Résumé in *Ann. de Géogr.*, Vol. 26, 1917, pp. 255–272.

gage though they saturate the air, or in the form of fogs, of which the *crachin* of Brest is typical. Under the humid atmosphere the contours of the landscape are softened, and the penetrating moisture gives a pervasive air of freshness. This is so even in the least humid part, the southeast. At La Flèche, for example, where the exceptionally low rainfall of 541 millimeters would lead one to expect a drier country, the frequent drizzles are such that visiting strangers complain of the excessive humidity.

Human Adaptation to Natural Conditions

There are in France other regions of impermeable rock; and, while the influence of the oceanic climate diminishes eastward, it is still apparent far beyond our region. But here in the west the influence of these conditions appears the more pronounced because of the human adaptations that have been made to them. Three of these adaptations are particularly striking: the grouping of population, communications, and the separation of the cultivated fields.

Population Grouping

Dispersed dwellings accommodate an important part of the population. Not that all are isolated, however: the common type of settlement is intermediate between that of complete dispersion, nothing but isolated houses, as in Chalosse (southwestern Aquitaine), and perfect agglomeration with all the houses grouped round the church, as in Beauce. Every village of the western region includes two parts: the *bourg*, or little market center clustered round the church, and the *écarts*, or dispersed houses. These latter either are gathered into hamlets, like the *plou* of Lower Brittany, or into groups of two or three, or, as often, stand isolated. The origin of this arrangement is still obscure; but, whatever it may be, it is clearly well adapted to physical conditions. It is made possible (not determined) by the distribution of water which, furnished by the humid climate and retained by the impermeable soil, can be found everywhere near the surface. Exceptions appear only where the surface rock is permeable, for example in the *plaines* of Caen and Argentan and in a part of Alençon, where habitations are perforce grouped in a fashion different from the rest of the region. The countryman of the West prefers his isolated *borde* (little property) to the village. It is better adapted to his method of cultivation. What he wants is to be close to his fields to curtail as far as possible transportation and movement back and forth.

Means of Communication

Difficulty of communication that weighs on all forms of activity is another consequence of physical conditions.

A century ago the main highways were few and ill-kept, and the country roads were almost impracticable. In the West they have a peculiar physiognomy. They are narrow and overtopped on either side with sloping banks over which trees, bushes, and briars form a tangle of vegetation. The roads

are as deep-sunk as trenches; when it rains, streams of water course along them; and at all times they hold thick mud. Carriages are mired therein; pedestrians prefer to travel through the fields where the pathways, or *chintres*, are better suited to their needs.

A journey by such roads is quite an undertaking. The physician Réaumur described travel in the Vendée in the early eighteenth century: "The axles of the little wheels of my coach," he wrote, "were constantly mired, and during the ten leagues of the journey it was continually necessary to widen the road: progress was made only with the help of the soldiers whose business it was to clear the way."[6] The deep-sunk roads of this region which lent themselves so well to ambuscade became famous by the "wars of the Vendée" during the French Revolution. Today the highways have been improved, but the byways remain almost in the same state; the difficulty of transportation is ameliorated but not eliminated; it is still characteristic of western France. Physical circumstances are largely accountable: the impervious rocks hold the water, and the humid climate loosens the soil; but the slopes and hedgerows that enclose the roads are responsible in part.

The "Bocage"

Not only the roads but the fields also are bordered by sloping banks, called *fossés*[7] in the West, which enclose them as entrenchments. Entrance to a field is only by way of its barred gate. The hedges are not simply boundary fences; each one covers considerable ground and is quite impenetrable, a little thicket—one might even say a little wood. Concerning their origin and purpose nothing is known. Whatever it may be, they present the most striking feature of the western landscape; they give it the appearance of *bocage*, that is to say country covered by thickets of trees and shrubbery. The *bocage* was formerly more developed than it is today; it is now restricted for the most part to the impermeable soils, whereas once it covered permeable soils as well, in Lower Normandy for example. The influence of physical conditions is manifest. It is, however, a particularly important point that the limit of the *bocage* coincides with that of the impermeable rocks only to the south of the Loire; to the north it cuts in two the uniform stretch of the great impervious clay-with-flints plateau. Now this limit (Fig. 1) is exactly coincident with that accounted by popular speech as the beginning of the West. To the country folk the West is essentially the region of *bocage*.

In this respect it forms a contrast with the surrounding countries. When once the border of the *bocage* is crossed the landscape is strikingly changed—

[6] *Mémoires de l'Acad. Royale des Sci.*, Jan. 21, 1921. On the same region see Dupin: Mémoire statistique du département des Deux-Sèvres, Paris, An. 12, p. 138. Similar testimony abounds for all parts of the West; for Bas-Maine see Musset, *op. cit.*, pp. 319–324; for Anjou, Leclerc-Thouin: De l'agriculture de l'Ouest de la France, etudiée plus particulièrement dans le département de Maine-et-Loire, Paris, 1843, pp. 170–174; for the Norman Bocage, J. Lecoeur: Esquisses du Bocage normand, Condé-sur-Noireau, 1883; for Brittany, J. Letaconnoux: Les subsistances et le commerce des grains en Bretagne au XVIIIe siècle, Rennes, 1909, p. 253.

[7] *Fossé* is literally "ditch," but in the west of France it is used in exactly the inverse sense, i. e. as "bank."

no more hedges, but a monotonous expanse of fields defined only by invisible bounds or conventional lines and stretching out to an infinite horizon. Such a country is *plaine*, a word of precisely contrary sense to *bocage*. Within the *bocage* itself *plaine* is used to describe areas free from *bocage*—whether of considerable extent, as on the permeable soils, or of limited size, as certain land used only for pasture or the ensemble of tiny fields which several neighboring farmers may have thrown together for cultivation in common.

The Isolation of the West

Hedge-enclosed fields, scarcely traversable roads, dispersed dwellings, all contribute to the same effect. The country is parceled up to an extreme degree, and each part is isolated. Every village, hamlet, or isolated farm is sufficient to itself. To travel from his field, his hamlet, his village is a serious matter for the countryman. Occasions for meeting his fellows are rare. They are confined to Sundays, when the people go to town to hear mass or to make their purchases; and to the fairs which at long intervals enliven for a day the little towns ordinarily dead. These circumstances are reflected in the character of the people. The customary portrait of the people of the West is not altogether satirical. It is said that they are suspicious of the new and strange; they avoid or receive with reluctance the outsider, *le horsain* or *le hors-venu*, as the Normans call him; they reject innovations, clinging tenaciously to the traditional. A French writer, M. Siegfried, in a penetrating study [8] has shown how the political life of the West, this stronghold of French conservatism, is in sum the consequence of geographical conditions.

Subdivisions of Western France

Uniform as a whole, subdivided to an extreme degree in detail, markedly different from the surrounding regions—such is western France. Within it one cannot recognize any natural regions, or *pays*, as in the Paris Basin for example.[9] Here the only living unit is the village. Only on the border can *pays* be distinguished by contrast with the country beyond: the *pays* of Auge, lying between the clay-with-flints plain on the east and the plains of Lower Normandy on the west; the Perche, defined by contrast with the neighboring plain of Beauce.[10] As to the names "Bocage normand" and "Bocage vendéen," they are only general terms applied without any precise limits. The old names of provinces—Normandy, Maine, Anjou, Brittany, Poitou—are of historic origin and have no true geographical significance. Other old territorial divisions of vague bounds are occasionally preserved by local tradition—Léon, Cornouaille, Broweroch—but often they have entirely fallen out of use, as in Brittany those of Penthièvre, Trégorrois, and Porhoet.

Yet certain parts of the landscape detach themselves from the general

[8] André Siegfried: Tableau politique de la France de l'Ouest sous la Troisième République, Paris, 1913. See the review by Paul Vidal de la Blache, *Ann. de Géogr.*, Vol. 23–24, 1914–15, pp. 261–264.

[9] See Lucien Gallois: Régions naturelles et noms de pays: Étude sur la région parisienne, Paris, 1908.

[10] René Musset: Le Perche, nom de pays, *Ann. de Géogr.*, Vol. 28, 1919, pp. 342–359.

picture by virtue of some trait of individuality. Such are the rare *plaines* occurring in the midst of the *bocage;* the *plaines* of Caen and Argentan, the champaign of Alençon, the plain or *bas-pays* of the east of Cotentin; the valleys of the larger rivers with alluvial floors devoted to market gardens and slopes given to vine cultivation, to which the term *val* is usually applied—val d'Anjou, val de Loire, val du Loir—and, in Anjou, that curious valley of the Authion known simply as "la Vallée;" the low, marshy regions along the coast now more or less drained (*marais*)—the marshes of Carentan to the south of Cotentin, of Dol in Brittany, the Breton and Poitevin marshes in Vendée. And finally there is a distinction born of proximity to the sea. In Brittany, where the extreme indentation of the shore line has intensified maritime pursuits the narrow littoral band shows a distinctive type of life; the people are both farmers and sailors. The farmer keeps the typical traits of the West; the sailor, engaged in navigation and fishing, makes outside contacts to which he succumbs in the end though he may be mistrustful in the beginning. Thus is created the difference between maritime Brittany, or Armor (the country of the sea), open to the outside world, and interior Brittany, or Arc'hoat (the wooded country), the most backward part of the entire West.[11]

Recent Changes

The picture we have drawn is in process of transformation. This is especially so in respect of agricultural development.

Nothing could be more monotonously uniform than the old-time agriculture of the West; a single system prevailed throughout the region. Land was divided into two parts, the fields devoted to crops, far the less extensive in area, and the "idle" land which included the fallow fields and the pastures. The fallow fields were left for 2 or 3 or 10 years and 15 or 20 years; while the pastures consisted of the *landes*, deforested areas never cultivated. As the soil is naturally deficient in plant foods and lacks the two essential elements, lime and phosphoric acid, only the inferior cereals could be grown, barley, rye, oats, and buckwheat, from which was made a coarse bread eaten as sops or in thin cakes. The animals for lack of phosphate of lime were undersized though hardy. This inferior agriculture had but one object, to provide for the needs of the people themselves, and for this it did not always suffice. The West was too isolated and subdivided to engage in foreign commerce; the sole export was cattle in limited number—the only product, as an old writer has said, "that could transport itself."

But towards the middle of the nineteenth century the opening up of the West began. The central administration of France paid careful regard to the development of communications, constructing roads and railways and bringing the various regions of the country in touch with each other and with the outside. This was the point of departure for a complete revolution

[11] Emmanuel de Martonne: The Real France, *Journ. of Geogr.*, Vol. 18, 1919, pp. 81–94.

in agricultural methods. The soil was enriched by the addition of lime and fertilizers; wheat began to replace rye and to make inroads on the acreage planted to other cereals. The West, which till then had asked only its daily bread and had cultivated grain in preference to raising cattle, now began farming for export and concentrated its efforts on those products it could sell to the best advantage; it turned to its natural vocation, cattle raising favored by the good pasturage of this humid land.

The agricultural transformation of the West has tended to give the region a diversified aspect unknown before. The movement began at different times in different parts, and not all regions have progressed at the same pace. On the whole the change commenced on the eastern border and traveled westward; it has been completed in Normandy, Perche, Maine, and almost all Upper Brittany; it is in progress in the Norman Bocage and the north of Cotentin; it has scarcely begun in Lower Brittany, where there are great stretches of *landes* and fallow fields.

Nor has transformation everywhere followed the same course. The uniform agriculture of former times has given way to different adaptations in different places—on the border, within the *bocages*, on the *plaines*. Live stock is bred in the *bocage* and fattened on the *plaines*. Thus the young animals, horses and cattle, raised in Cotentin, the Norman Bocage, and Bas-Maine are sent to the *plaines* of Lower Normandy; those of Vendée to the *plaines* of Haut-Poitou and Charentes; the Perche is similarly associated with the Beauce in the raising of horses. The building of railways has permitted the extension of such relations. Cotentin, the Norman Bocage, Bas-Maine, Anjou, Vendée, and certain corners of Brittany ship young animals long distances. Bas-Maine, for instance, sends cattle to be fattened into Poitou, northern France, and even Belgium; Léon, in Brittany, sends foals to the plain of Valence whence they are finally sold to the vine-growing regions of the Midi. The most important branch of the pastoral industry, cattle raising, is specialized into three distinct types. Such sections as Perche, Cotentin, the Norman Bocage, Bas-Maine, northern Anjou, and Vendée are interested primarily in the breeding of animals to be sold while young. In other sections, devoted to dairying, stock is largely limited to milch cows; such is Brittany, a great producer of milk and butter. Other areas—the *pays* of Auge, the region of Merlerault, the *plaines* of Lower Normandy—combine dairying with the fattening of cattle; southern Anjou and Mauges have almost entirely specialized in the latter. In the West generally the raising of meat cattle is on the increase.

Conclusion

Present-day evolution is tending to a profound modification of the life of western France, making of it a region less isolated and less uniform. The process, however, is far from being complete; it has transformed only the economic life and this not everywhere to the same extent; certain remote

corners of Brittany still present a faithful picture of the former life of the entire west country. Modification is on the surface; the heart of things remains as of old. The modern spirit has penetrated only the border region: the mentality of the people as a whole, molded by centuries of isolation, is scarcely changed. In France the West represents the conservative, tradition-keeping element, accepting material progress but jealously retentive of the traditional modes of thought and action.

CLIMATIC PROVINCES OF THE RUSSIAN FAR EAST IN RELATION TO HUMAN ACTIVITIES

By Stanislaus Novakovsky

Clark University

In the extreme northeast of Siberia fish takes the place of bread. A fish famine brings the same dire results there as a bread famine in Europe. A large proportion of the population is engaged in fishing. In the success or failure of the industry climatic conditions play a considerable part. A fog in London may deprive many people of pleasure and may have some slight effect on retail trade and the stock exchange, but in far northeastern Siberia fogs may spell disaster to many hundreds of people. In this area the greater part of the summer is characterized by cloudy or foggy days which not only reduce the catch but are unfavorable to its preservation. The lack of salt and the primitive methods of salting compel the fishers to resort to sun-drying. But drying of the fish must take place in the second half of July and in August when clear days are few and far between. Fortunately, however, as if in compensation for this niggardliness Nature sends cold weather early, thus providing an alternative method of preservation—by freezing.

Besides cloudiness there are other climatic factors which militate against the fishing industry—the long winter, the freezing of the harbors and closure of navigation, the autumn cold spells, and the strong winds. The effect of such conditions might be indicated for other branches of industry. What they are and how they affect different parts of the great region known as the Russian Far East it is the purpose of this article to describe.

Dominant Factors in the Climate of the Russian Far East

The Russian Far East comprises the four administrative provinces of Amur, Primorskaya (Maritime Province), Sakhalin, and Kamchatka. The territory covers an area of approximately 937,000 square miles, three and a half times the size of Japan.

The territory forms a longitudinal strip extending from within the Arctic Circle to about the latitude of New York and lying between the greatest body of water in the world and the greatest land mass. It is dominated by winds of a monsoonal type. The easterly and southeasterly winds of summer bring the greater part of the rainfall, the westerly and northwesterly winds of winter bring dry cold. The pole of winter cold, in northeastern Yakutsk Province, is not far distant. On the other hand the region is clearly distinguished from the Siberian interior by modification of continentality, partly due to proximity to the sea, partly to the relief. In respect of the influence of

the sea, note should be made of the dominantly cold currents originating in the Sea of Okhotsk, in which floating ice is found the greater part of the year. The warm Kuro-siwo has very limited effect in the region.

As a whole the relief of the region is considerable. The Stanovoy and Khingan Ranges constitute a barrier against the cold winds of the Asiatic interior and limit the zone in which is felt the moderating influence of the sea. In detail the effect of the orography is seen in the pronounced local variations in climate. Some of the sheltered valleys are warm and, accumulating a deep snow cover in the winter, have a warm soil also. In others the phenomenon of temperature inversion is pronounced. A local influence is also exerted by the cover of *taiga*, the damp, tangled Siberian forest. The diurnal effect, higher night and lower day temperatures, is quite appreciable, and there is also a slight seasonal modification of temperature.

The several climatic regions into which the Russian Far East can be subdivided will now be described.

The Anadyr-Chukotsk Region

The Anadyr-Chukotsk region covers an area of 222,000 square miles and consists of three parts, the southern part or basin of the Anadyr, the northern, practically uninhabited and scarcely known save along the Arctic shore, and the eastern peninsula, Chukotsk (Chukchi). The relief of the Anadyr subregion is very diversified. A central depression is flanked on the west by a branch of the Stanovoy Range; on the east appear the harsh crest lines of the range extending north from Kamchatka. In the northern and eastern regions are long ranges, disorganized groups of mountains, plateaus, and hilly lowlands. The ranges, however, do not attain any great elevation, and relief here lacks the significance that attaches to it elsewhere in the Russian Far East.

Data on climate are scant. We have records from the stations of Markovo, 200 miles up the Anadyr, and Novo-Mariinsk at the river mouth, and the coastal strip is known to some extent from the observations of travelers and navigators, Nordenskiöld and Bogdanovich in particular. The general opinion of travelers is expressed in the words of Captain Billings[1] who explored the Chukotsk peninsula from Bering Strait to Nijnekolymsk towards the end of the eighteenth century: "The land of Chukchi is nothing but a mass of naked stones; its climate is most unbearable, nothing like summer until the 20th of July, and about the 20th of August the approach of winter is noticeable." The climate of this northern extremity of Asia cannot, however, be dismissed in quite so summary a fashion; though it is true that it is distinguished by its severity and arctic character, as observations at the meteorological stations show.

The mean annual temperature of Novo-Mariinsk is −7.9° C. (17.8° F.); Markovo is more extreme and has a still lower average for the year, −9.1° C. (15.6° F.).

[1] G. Sarychev: Journey of Captain Billings through Chukchis Land, St. Petersburg, 1811.

CLIMATIC REGIONS
1 ANADYR-CHUKOTSK
2 KAMCHATKA
3 OKHOTSK
4 RUSSIAN SAKHALIN
5 MARITIME
6 AMUR
7 USSURI
RUSSIAN FAR EAST
200 0 200 400 600 800 KILOMETERS
100 0 100 200 300 400 500 MILES
METERS FEET
2000 6560
1000 3280
500 1640
Anadyr
Novo Mariinsk
Markovo
BERING SEA
Petropavlovsk
SEA OF OKHOTSK
Okhotsk
Ayan
Nikolaevsk
Amgun
Alexandrovsk
SAKHALIN
Imperator Hbr.
Khabarovsk
Zeya
Amur
Blagoveshchensk
GREAT KHINGAN MTS.
LESSER KHINGAN MTS.
Lake Khanka
Ussuri
Sungari
SEA OF JAPAN
Vladivostok
120
130
140
150
160
170
180
70
60
50
40

FIG. 1

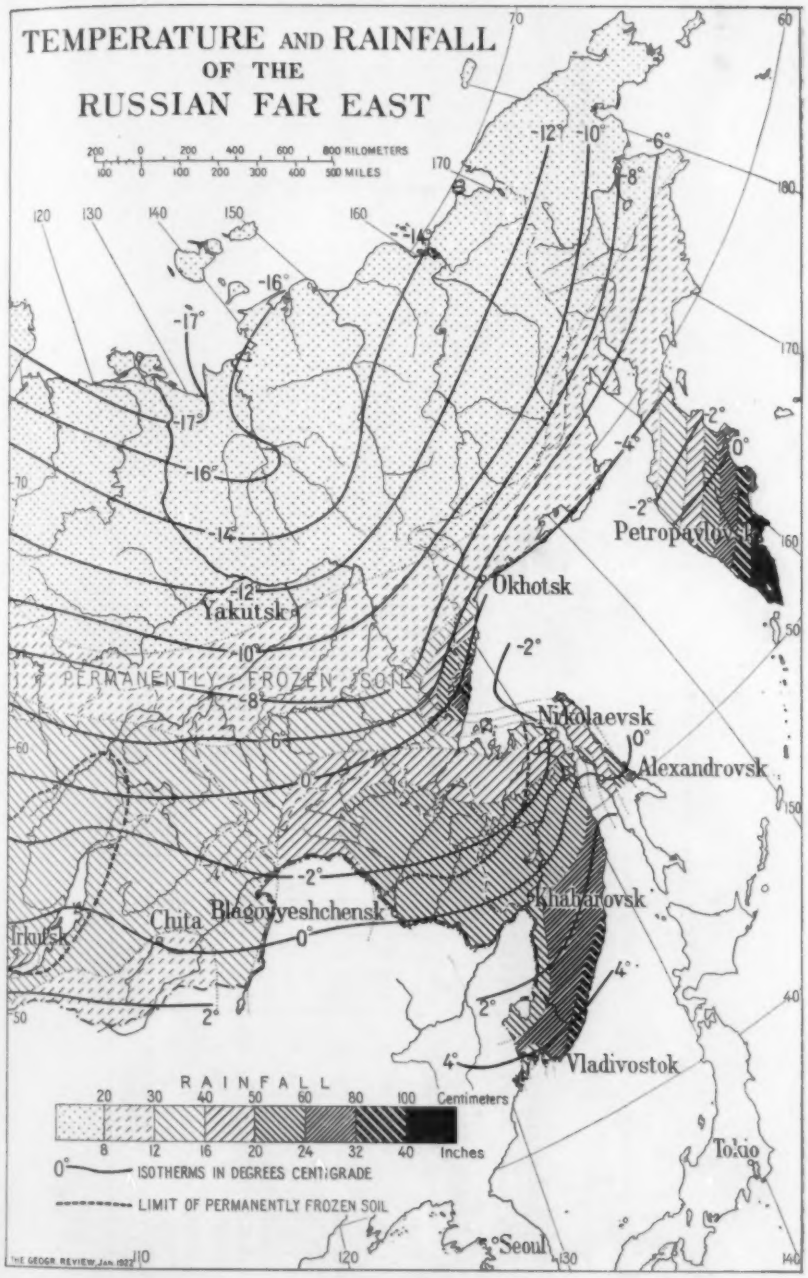
TEMPERATURE AND RAINFALL
OF THE
RUSSIAN FAR EAST
200 0 200 400 600 800 KILOMETERS
100 0 100 200 300 400 500 MILES
-12°
-10°
-8°
-6°
-14°
-16°
-17°
-4°
-2°
0°
2°
4°
Petropavlovsk
Okhotsk
Yakutsk
PERMANENTLY FROZEN SOIL
Nikolaevsk
Alexandrovsk
Khabarovsk
Blagoveshchensk
Chita
Irkutsk
Vladivostok
Tokio
Seoul
RAINFALL
20 30 40 50 60 80 100 Centimeters
8 12 16 20 24 32 40 Inches
ISOTHERMS IN DEGREES CENTIGRADE
LIMIT OF PERMANENTLY FROZEN SOIL
THE GEOGR REVIEW Jan 1927

FIG. 2

TABLE I—MEAN MONTHLY AND ANNUAL TEMPERATURE IN THE RUSSIAN FAR EAST

(In degrees Centigrade)

STATIONS	LATITUDE	LONGITUDE	YEARS OF RECORD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
ANADYR-CHUKOTSK REGION																
Novo-Mariinsk	64°45′N.	177° E.	6	−22.6	−24.9	−20.0	−13.4	−2.9	−4.9	11.2	9.3	3.7	−5.0	−14.8	−20.9	−7.9
Markovo	64°45′	170°50′	9	−30.1	−27.1	−21.2	−13.8	−2.3	10.3	14.2	10.5	3.2	−8.3	−19.6	−25.1	−9.1
KAMCHATKA REGION																
Petropavlovsk	52°53′	158°47′	8	−10.8	−11.3	−7.5	−1.6	2.8	7.4	11.5	12.3	9.6	4.0	−2.3	−5.8	0.7
OKHOTSK REGION																
Okhotsk	59°21′	143°17′	5	−23.1	−22.4	−15.0	−6.4	0.7	6.1	12.4	12.1	7.8	−2.7	−14.5	−20.7	−5.5
SAKHALIN REGION																
Alexandrovsk	50°54′	142°10′	20	−19.5	−15.7	−9.7	−0.4	5.1	10.7	15.9	16.2	12.0	3.9	−5.4	−13.1	0.0
NIKOLAEVSK REGION																
Nikolaevsk	53° 8′	140°43′	19	−24.5	−20.5	−12.0	−1.8	4.0	11.4	17.1	16.1	11.7	2.2	−9.0	−19.1	−2.0
AMUR REGION																
Blagovyeshchensk	50°16′	127° 0′	10	−24.0	−18.7	−9.0	2.5	10.5	17.6	21.3	18.9	12.6	1.2	−9.8	−20.6	0.3
Cherniaevo	52°47′	126° 0′	5	−27.5	−21.5	−12.3	0.5	9.5	16.5	19.3	17.0	10.3	−2.4	−16.2	−24.3	2.6
USSURI REGION																
Khabarovsk	48°28′	135° 7′	8	−23.4	−18.7	−9.2	3.0	11.0	17.4	21.2	20.0	13.2	4.0	−7.7	−18.5	1.0
Vladivostok	43° 7′	131°55′	20	−13.8	−10.3	−2.7	4.9	10.0	13.9	18.6	21.0	16.8	8.8	−0.1	−9.3	4.9

TABLE II—MEAN MONTHLY PRECIPITATION IN THE RUSSIAN FAR EAST

(In millimeters)

STATIONS	YEARS OF RECORD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
ANADYR-CHUKOTSK REGION														
Novo-Mariinsk	7	9.6	4.9	6.3	9.0	9.0	29.4	43.7	53.6	41.5	34.1	19.9	13.2	272.9
Markovo	11	7.6	6.6	7.2	3.9	5.2	22.9	33.3	36.8	29.4	11.7	8.8	8.3	181.8
KAMCHATKA REGION														
Petropavlovsk	10	60.4	50.4	51.1	49.3	63.1	66.7	73.0	119.7	100.9	130.4	85.4	59.3	920.9
OKHOTSK REGION														
Okhotsk	4	1.7	1.1	4.0	16.6	19.5	52.5	50.9	25.5	36.3	24.0	2.8	4.9	236.8
SAKHALIN REGION														
Alexandrovsk	5	49.0	24.8	54.0	32.4	34.8	23.0	53.0	42.8	89.5	96.8	30.2	60.8	591.1
NIKOLAEVSK REGION														
Nikolaevsk	16	24.0	15.5	21.1	35.0	29.7	29.5	51.3	82.8	66.1	66.3	38.3	28.4	496.1
AMUR REGION														
Blagovyeshchensk	5	3.9	0.3	1.8	16.4	52.5	67.9	135.2	122.2	98.5	29.8	5.6	1.8	535.9
Cherniaevo	6	2.5	2.5	5.1	14.1	43.3	54.9	91.1	100.5	34.7	15.9	7.2	6.2	378.3
USSURI REGION														
Khabarovsk	4	4.1	7.2	10.2	23.0	61.4	100.5	107.1	113.9	54.5	36.3	14.8	11.5	544.6
Vladivostok	18	6.1	7.9	11.3	25.8	53.0	63.2	74.1	132.9	108.8	45.4	13.4	11.6	554.5

Spring and autumn are so short that only two seasons can be properly recognized, winter which lasts nine months and summer lasting three months. This explains the fact that nearly all the soil of the region is permanently frozen, never thawing to a depth of more than 20 to 40 centimeters below the surface.

Though precipitation is small (10 inches in Novo-Mariinsk, 7 inches only in Markovo), humidity is high; and the percentage of cloudy and foggy days is very great. The average for many years gives Markovo only 63 clear days a year, Novo-Mariinsk, 69. In general only one month in Markovo (July) and two in Mariinsk (July and August) are free from snowfall; but the number of snowy days is not great—for the former station it averages 72, for the latter 71—nor is the fall heavy. The River Anadyr is ice-free for about four months, mid-June to mid-October.

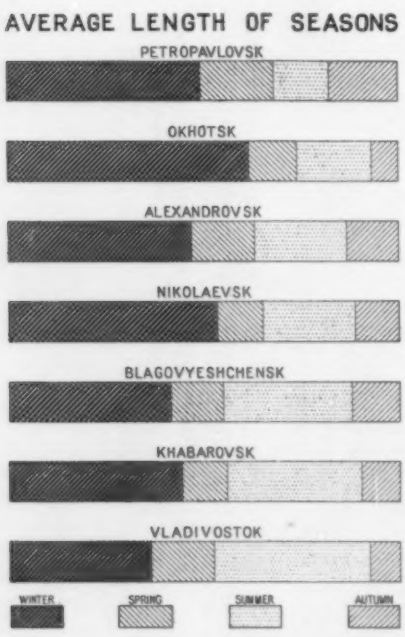

FIG. 3—Average length of seasons in the Russian Far East.

The vegetation is naturally feeble and scant. In the more westerly part and the middle of the Anadyr basin there is a stunted forest growth, chiefly poplar, alder, and larch. A sizable broad-leaved forest is found on the mountain slopes upstream of the Anadyr and its tributaries. In general the boundary line of the forested area may be placed at 169° E. longitude. Eastward is tundra, frozen in winter, swampy in summer. Forest growth is in part restricted by the powerful destructive winds that carry masses of frozen snow mixed with sand and exercise a marked scouring effect on the rocks.

At Markovo the frost-free period ranges from 65 to 90 days, and the vegetative period is correspondingly short. The period of active growth is considered as that with the average daily temperature reaching 6° C. (43° F.) or more. At Markovo it extends from June 4 to September 10, and the total of heat units (total of average daily temperatures above freezing point) for this period is 1,204. Now 1,000 heat units are sufficient for agriculture in some circumstances, but here there are other unfavorable conditions—the high degree of humidity, and cloudiness, the number of rainy days in the summer season, the cold winds. Inhabitants of Markovo have attempted to grow vegetables, but the results were not worth the time and trouble that

had to be expended. The basis of life in this region depends upon the sea fisheries, hunting, and reindeer breeding.

The Kamchatka Region

The Kamchatka region includes the peninsula of that name and the adjacent islands. The northern part of the peninsula is plateau diversified by hills and open to the influence of the Bering and Okhotsk Seas. The rest of the region is characterized by two parallel ranges of volcanic mountains running its length and separated by the wide valley of the Kamchatka River.

The climate of Kamchatka is distinctly milder than that of the Anadyr-Chukotsk region. Winter lasts 6½ months instead of 9, and there is a comparatively long spring. The mean annual temperature (for an eight-year period) of Petropavlovsk is 0.7° C. (33° F.).

Orography and the direction of the prevailing winds—westerly in winter and easterly in summer—clearly differentiate the eastern and western coasts. However, they may both be described as having a semioceanic climate, while the shut-in central section is semicontinental and the exposed north cold continental in character. The lowest mean monthly temperature of Petropavlovsk (February) is −11° C. (12.2° F.), and the minimum −20.4° C. (−4.7° F.); the highest monthly mean (August) is 11.7° C. (53° F.), and the maximum 26° C. (78.8° F.). Petropavlovsk is on the eastern shore, and its temperature appears to be influenced to some extent by a drift (Kamchatka Current) from the warm Kuro-siwo. Bolsheretsk on the western shore is colder, while Kluchevskoye in the interior is still more extreme. The lowest mean monthly temperature at the latter (January) is −18.2° C. (−0.7° F.), and the minimum (February) −36.3° C. (−33.3° F.); the highest monthly mean (July) is 12.1° C. (53.7° F.), the maximum (June) 24.9° C. (76.8° F.).

Precipitation in the Kamchatka region is comparatively heavy and is more equably distributed through the year than in any other region of the Far East. Fifty per cent of the fall is as snow. Indeed, the peninsula is renowned for its violent snowstorms. The huge snowdrifts do not melt until late in the year. The fishermen, who gather about the middle of May to resume fishing, often find their stations completely snowed under. A cold and snowy winter, however, is frequently followed by bright sunny days, especially in March which is the most convenient month for making trips over the country. The rather considerable heat of the sun alternating with the night cold helps to form a solid crust of ice on the surface of the snow, thus facilitating driving. "During this season," says Ditmar,[2] "all the localities of the peninsula seem to be drawn closer together, as the distance between them is more rapidly covered."

The Petropavlovsk section of Kamchatka is situated in the same latitude as Samara, the great wheat-growing region of the middle Volga, but experi-

[2] K. Litmar: Kamchatka, St. Petersburg, 1901.

ments in cereal production in the former district have proved failures. While the grain reaches a formidable height, the ears form very late and are either caught unripened by the frosts or ripen in September to a poor yield. The total of heat units for the vegetative period, May to September, is 1,507 for Petropavlovsk and 1,651 for Kluchevskoye, but the destructive frosts of late spring and early fall, the clouded skies of summer, and the high humidity are deterrent.

On the basis of climate and topography the natural vegetation of the peninsula may be subdivided into coastal and inland types. In the former, shrubs and tundra predominate; in the latter, conifers. The meadows with their luxuriant grasses furnish good grazing for cattle.

The Okhotsk Region

The Okhotsk region is a narrow strip along the northern and western shores of the Okhotsk Sea extending from the border of the Maritime Province to the northwestern corner of Kamchatka. It is cut off from the neighboring regions by the Aldan Mountains, the numerous branches of which give the coastal region a hilly character everywhere except in the north. The considerable relief in combination with the effect of the cold waters of the Okhotsk Sea make the climate abnormally cold and damp for its geographical position. The mean annual temperature of Okhotsk (town) is −5.5° C. (22° F.). The presence of masses of floating ice along the shores lowers the temperature of spring and summer. The former season is much shorter here than in Kamchatka, shorter even than in the Anadyr-Chukotsk region. Associated with the coldness of the sea waters is the prevalence of foggy and cloudy days. Thus in 1915 the town of Okhotsk had only two clear days in June, none in July, seven in August.

The winter is very cold, fairly snowy and stormy, and at times subject to spells of extreme cold. Autumn also is short and cold. Very low minima are observed even in October; for example in 1915 the October minimum for Okhotsk was −21.3° C.

Although the number of heat units received during the vegetative period, June to September, is not inconsiderable—1,057 for Okhotsk—the same unfavorable factors, principally lack of direct sunshine, operate as in the Kamchatka and Anadyr-Chukotsk regions and preclude all possibility of agriculture beyond the raising of certain vegetables.

The humidity of the climate, to which the slow thawing of the snow on the mountains and the *taiga*-covered slopes appear to contribute, is especially unfavorable. Heavy dews are experienced in the late summer and early autumn. The effect of the unusually high degree of moisture in the air has been described by Dr. Slunin:[3] "On the steep banks eroded by the river in its course there hung on every leaflet and stalk, as well as on the roots of shrubs and plants, beads of silvery dew refracting the rays of the morning

[3] N. Slunin: Okhotsk District and Kamchatka, St. Petersburg, 1900.

sun in the colors of the rainbow. Large glittering drops fell from every peat mound. The whole tundra, as they say, was weeping. As you glide down a river in a canoe, you meet with the like enchanted scenery for miles and miles and day after day. We were sometimes driven desperate by the unbearable moisture of the air."

The open exposed plain of the extreme north of the region is tundra; the remainder of the country is largely covered with *taiga* in which the trees, especially near the coast, are deciduous for the most part—birch, poplar, and alder. The influence of the wind on forest growth is most pronounced. In sheltered valleys tall fine trees are found; in exposed places they are stunted and twisted to an extraordinary degree.

The general poverty and monotony of the region is such that one cannot but admire the inventiveness of the native in his utilization of the natural resources. From a nettle the Koryak and Kamchadale manufacture a kind of hemp; from the sea grass, one of the most luxuriant features of the flora, they braid bags and mats; a species of alder gives material for the dyeing and tanning of reindeer hide.

The Sakhalin Region

The island of Sakhalin stretches as a long narrow band along the eastern shore of the Maritime Province, being separated from it by the northern part of the Japan Sea. The northern part of the island, that belonging to Russia, has an area of about 15,000 square miles. The island is traversed by a series of meridional mountain ranges. The first of these ranges stretches from the northern tip of the island to latitude 51° 21′, from which point southward the inner part of the island is lowland, the basin of the Tymy River, the largest river of Russian Sakhalir. Flanking the central lowland are western and eastern coastal ranges. Nowhere is the elevation great. Even the highest peaks of the Eastern Coastal Range do not rise over 3,000 feet.

The climate of Sakhalin, generally speaking, is cold and humid, especially on the coasts. Alexandrovsk on the west coast has a mean annual temperature of 0.° C. This coast, facing the Straits of Tartary, is somewhat milder than that of the east, facing the Sea of Okhotsk, and appears to show the influence of a branch of the Kuro-siwo diverted thither from the stream passing through La Pérouse Strait.

The average annual precipitation in Sakhalin is about 600 millimeters (24 inches) and, like that of Kamchatka, is well distributed through the year though still heavier in the summer and autumn. The summer rains are noted for their intensity. Snow falls eight months of the year, from October to May.

Heat units during the vegetative period at Alexandrovsk, April 27–October 2, amount to 1,934; but the same objectionable factors are present as in the Okhotsk region. In particular mention should be made of the salt

sea fogs of the coastal regions. The sheltered valley of the Tymy is, however, more favorably circumstanced.

The considerable variation of climate throughout the length of Russian Sakhalin, 900 miles, is well reflected in the vegetation. Tundra occurs in the north; but nine-tenths of the island is wooded, and the southern portion has a rich variety of species, northern and southern forms mingling. In the latitude of Alexandrovsk the Kurilian bamboo is found. The vegetation appears to be richer for the most part on the mountain slopes facing the Straits of Tartary, much poorer on the slopes exposed to the Okhotsk Sea. Emphasis must be laid on the effect of local conditions. The estuary of Poronay (in Japanese territory), lying in an exposed situation, has a typically arctic flora; while in the extreme north are sheltered spots where tundra is replaced by trees.

The Nikolaevsk Region

The Nikolaevsk, or Udsk, region is coincident with the administrative subdivision of Uda, the main portion of which in 1914 was separated from the Maritime Province and temporarily placed under the local Sakhalin government. A large part of the region, particularly north and west of the Amgun, is practically unknown country. The area of the region is about 38,000 square miles, and it is very scantily populated. In 1909 there were only 13,749 souls of whom 12,700 lived in the city of Nikolaevsk. The relief is generally mountainous, though there are several extensive depressions. A continuation of the Little Khingan of northern Manchuria traverses the southern part of the region as the Bureya range and reaches altitudes of 3,000 to 5,000 feet above sea level. In the north are ramifications of the Stanovoy Range. The most important lowland is that of the Lower Amur which in its central part attains a width of 100 miles.

The climate of the best known part of the region is subject to influences similar to those obtaining in the Okhotsk region. The winter is severe and lasts almost half the year. Spring and summer are late and short especially near the coast, washed as it is by ice-laden currents. Thanks to the presence of the sea, however, the autumn is warmer along the shore and may be considered the best season of the year.

There is considerable local variation in temperature. Layers of cold air tend to accumulate in the depressions and flow along the river courses. For this reason the Amur valley stays very cold. During January the average temperature of Nikolaevsk drops to −24.5° C., while Ayan, situated farther north, has a temperature 6° higher. The length of the winter, with closing of the Lower Amur to navigation from the end of October until the middle of May, has been deterrent to the growth of Nikolaevsk; while its rival Vladivostok, climatically better favored, has succeeded. Of course other circumstances have also hampered development of the port—the bar at the mouth of the Amur, the lack of railroads and general backwardness of the hinterland, and military contingency. The mean monthly temperature is the same for the two stations, −2° C. (28° F.).

The rainfall is typically distributed. Thus in 1914 the total precipitation for Nikolaevsk during the six cold months was 88 millimeters (3.5 inches), for the six warm months 231 millimeters (9 inches). Other stations in the region show a more marked seasonal difference. Thus for Mariinsk, up the Amur, the seasonal distribution was 64 millimeters (2.5 inches) and 441 millimeters (17 inches) respectively. Unlike the case in the Okhotsk region fogs are of infrequent occurrence here.

The comparatively high temperatures of summer and autumn suggest possibilities of agriculture. At Nikolaevsk the total of heat units for the period of active growth is 1,752; the figure is higher for southern parts of the interior. The inhabitants of Novo-Sergievskoye, a village a few miles from Nikolaevsk supply themselves entirely with grain and sow fall rye and barley. Within a radius of some 100 miles from Nikolaevsk almost all kinds of grain ripen—rye, oats, and wheat; and 150 miles north of Khabarovsk even watermelons ripen well. Thanks to the industry of its Korean gardeners the city is supplied with home-grown vegetables in excess of its needs, and in recent years the surplus has been shipped south to Khabarovsk and Blagovyeshchensk.

The Amur Region

The Amur Province occupies an area of some 155,000 square miles. Across the northern part stretch the Stanovoy Mountains. The range, which here has a latitudinal direction, constitutes the boundary between the Yakutsk and Amur Provinces. The average height of the summits approximates 3,500 feet, individual peaks reaching 7,000 feet. From Manchuria the Great Khingan Mountains enter the southwestern corner of the region, forming the boundary between this province and that of Transbaikal. In the eastern part the Buryea Mountains continue the Little Khingan. Several minor ranges diversify the topography. One feature that claims special note is the Zeya-Buryea lowland covering an area of 65,800 square miles along the Amur and the lower courses of its tributaries from the Zeya eastward to the Buryea ranges. It is sometimes known as the Upper Amur prairie, is fairly well populated, and offers good prospects for agriculture.

The climate of the province is markedly continental, average and absolute ranges being great. In Blagovyeshchensk the absolute range for 1914 was 64.6°, i.e. from −34.9° C. (−30.8° F.) in January to 29.7° C. (85.5° F.) in August. It is still greater in other sections in the northwest: Dambuki registers −53° C. (−63.5° F.) in January, 30.8° C. (87.4° F.) in July. Though there are local differences, over the broad area of the province considered as a whole there is a noteworthy uniformity, and the climatic type is distinctive. Thus for a number of widely dispersed stations the extreme difference in length of winter is only 19 days, ranging from 205 to 186 days. Everywhere winter cold is intense and uniformly maintained without sharp fluctuations and accompanying thaws. Thickness of ice on the Amur reaches from three to eight feet in January.

The distribution of snow is very irregular; but in general the fall is light—only four per cent of the precipitation—and the snow is fine and powdery and easily blown away. In some parts of the country sleds are not used, whereas over most of Siberia they afford the chief means of winter transportation. Lacking a snow cover the rivers freeze to the bottom, the earth cracks in big fissures, and winter crops perish. In places the soil freezes to depths of seven or eight feet and thaws slowly so that spring sowing is delayed. It is not surprising that permanently frozen soil is encountered in many parts of Amur Province, whereas in Sakhalin the phenomenon is unknown. The problem of permanently frozen soil is a complex one. According to the authority Professor Yachevsky it involves not only low air temperatures and deficient snow cover but geological and hydrographical conditions as well. With the coming of warm days the whole character of the weather changes sharply. Though the winds still come prevailingly from the west, they are less regular; the number of cloudy days increases as does precipitation; sometimes there are fogs. In contrast with the uniformity of winter is the inconstancy of spring. The most unfavorable phenomenon is the late frosts. Near Blagovyeshchensk they continue to mid-May, and longer farther north.

The distribution of rainfall is typical. It is greater in the east than in the west, but everywhere Amur Province shares with the monsoonal lands of eastern Asia the preponderance of summer rain. At Blagovyeshchensk 85 per cent falls in summer and autumn.

On the question of the suitability of the climate for agriculture there are differences of opinion. The short autumn and long winter with low temperatures and freezing of the soil preclude fall sowing in most of the area. On the other hand, the summer averages about three months. At Blagovyeshchensk the total of heat units is 2,380. On the other hand summer rains hinder the ripening of grain; the heavy falls of rain do not readily drain off, and plants tend to rot. The barriers to agricultural development do not appear to be insurmountable, however. Much could be done by improvement of methods of cultivation and the selection of suitable seed. It may be noted that the practice of burning the forests helps to create a "dry fog," a phenomenon of common occurrence from May to August.

The table on the next page shows the yield in 1911 of certain crops in Amur Province compared with yield in interior eastern Siberia and European Russia in the same latitude.

The natural vegetation of the Amur Province is rich and diversified. Though the climate is markedly uniform, subregions may be recognized based on the vegetation:

1. Southwestern section characterized by the eastern larch (*Larix daurica*) and with steppelike meadows on the drier mountain slopes.

2. Northwestern section with the eastern larch and the white birch and occasionally pine and more rarely fir.

3. Southeastern section with Manchurian flora predominating, and

including the Manchurian cedar, oak, several species of maple, elm, and walnut. Many species are not found or are rare west of the Amur basin.

4. Northeastern section with Okhotsk type of flora, Ayan fir spruce, and moss swamps.

5. Northern section of poor vegetation.

TABLE III—CROPS IN POUNDS FROM 2.69 ACRES (1911)

PROVINCES	SUMMER WHEAT	SUMMER RYE	BARLEY	OATS	BUCKWHEAT	PEAS	POTATOES
Kiev	1,376	1,312	2,432	2,944	1,984	2,880	17,920
Transbaikal .	992	1,248	1,024	1,120	480	800	13,920
Amur	2,048	1,696	1,952	2,240	1,280	1,920	16,672

In general there is much swampy soil. Grasses flourish in great variety but are not of great value for cattle.

Analogous to the diversity of plants is the diversity of the animal life. There is a mingling of forms; such northern species as the reindeer with such southern species as the tiger, western species as the hedgehog with eastern species as the raccoon.

THE USSURI REGION

The Ussuri region constitutes the southern part of the Maritime Province, and its area is estimated at about 200,000 square miles. It is named from the River Ussuri, the course of which for the last 300 miles forms the boundary between the region and Manchuria. The only important depression is around Lake Khanka. The Sikhota-Alin range enters from the south running south-southwest to north-northeast along the coast of the Japan Sea and filling the entire region with its ramifications. It is not a single massive range as appears on most maps but a series of parallel chains. The general summit level is 2,000 to 3,000 feet; the greatest heights, with individual peaks attaining over 5,000 feet, are found in the south and center; approaching the Amur the mountains become lower and more rounded. The southern shore cuts across the grain of the country and is rich in inlets. North of St. Olga Bay the trend of the coast parallels the mountains and is broken only by Imperator Harbor.

The climate is cold for the latitude. The mean annual temperature is some 10° C. lower than for corresponding latitudes in western Europe, yet climatically the region is the best favored of the Russian Far East. The winter at Vladivostok lasts not more than five months. The Sikhota-Alin range is an important climatic divide, particularly in the south where the cloudy, foggy coast lands are sharply differentiated from the sunny interior. In 1914, from April to August, there were 48 foggy days at Vladivostok, and at some stations on the south coast this figure was doubled. Altogether four

climatic subregions can be recognized: (1) Southern Coastal region, (2) Southern Interior, (3) Central, (4) Northern. As illustrative of the difference between them we may note the mean annual temperature for 1914. For Vladivostok on the southern coast it was 5.5° C. (42° F.); for Chernigovka in the southern interior, 3.9° C. (39° F.); for Khabarovsk in the central district, 1.5° C. (34.7° F.); for Imperator Harbor in the north, −0.8° C. (30.5° F.). This range is largely due to differences in winter temperature. However, Imperator Harbor, washed by the cold waters of the Gulf of Tartary, has an abnormally low summer temperature.

Precipitation comes chiefly in the form of heavy summer showers not infrequently causing disastrous floods. There is, however, a rather critical variation in rainfall. Thus during the period 1899–1907 the range at Valdivostok was 257 millimeters (10 inches) to 853 millimeters (33.5 inches). In 1914, 904 millimeters (35.5 inches) was recorded. The amount of snowfall is likewise irregular in amount and distribution.

Assuredly there is a great economic future for Ussuri. It is well favored in respect of its coastal location and good harbors and interior waterways, in the presence of coal, iron, and zinc ores and building materials, and the proximity of important markets. In relation to the development of such resources the question of agriculture is of prime importance. What are the possibilities as regards climate? In the southern parts of the region the vegetative period approaches 200 days in length and even in the extreme north surpasses 100 days. The total of heat units (1915) at Vladivostok is 2,393; at Khabarovsk 2,554; at Imperator Harbor 1,612.

The greatest obstacles to agriculture are, in the north, the coldness of the coast in spring; in the south, the slow heating of the soil insufficiently protected with snow in winter and the fogs.

The agricultural products of the Ussuri region are characteristically varied. Fall and spring wheat, rye, oats, barley, buckwheat, and hemp are grown; also watermelons, melons, cucumbers, and all root crops. The numerous Chinese and Korean immigrants raise millet, beans, and corn, all of which do well; and in the last few years rice cultivation has been attempted and, contrary to all expectations, has succeeded. In regions where rice is grown in Europe, America, and most other parts of Asia the summer has not less than three months with a temperature above 22° C. (72° F.). We may, however, note the development of rice cultivation in Hokkaido where temperatures also are comparatively low. The warmest sections of Ussuri do not always have even one month with a temperature above 20° C. Rice was first planted in 1918, and two years later 6,725 acres were devoted to the crop. According to the estimates of A. D. Woeikof this acreage should be increased tenfold in 1921. Table IV gives some idea of the agricultural development of the region.

An index to the possibilities of agriculture is seen in the rich variety of the natural vegetation. Ussuri shares with the Amur region its character as a meeting place of northern and southern forms. The vegetation furthermore

TABLE IV—CROPS IN THE USSURI REGION (1911)

CROP	AREA IN ACRES	CROPS IN ENGLISH POUNDS	NUMBER OF POUNDS PER 2.69 ACRES
Winter wheat	228,800	120,528,000	1,344
Winter rye	4,420	3,065,600	1,760
Summer rye	23,140	10,582,400	1,184
Barley	15,080	10,096,000	1,728
Oats	208,520	138,432,000	1,728
Buckwheat	82,560	33,536,000	1,088
Millet	17,420	20,505,600	3,072
Peas	1,580	935,600	1,632
Potatoes	27,520	138,304,000	14,144

attains great luxuriance. The forests are impenetrable with twining plants and vines; the grasses grow to great heights. Exposure and relation to the sea play an important part. Whereas northward-facing slopes are forested, southern slopes are apt to be forestless, for the alternation of warm days and freezing nights of February ruptures the plant tissues. The *taiga* on the southeastern slopes of the Sikhota-Alin presents an imposing appearance; but the summer dampness rots the heart of the timber, and it is useless for any purpose except fuel.

COMPOSITE TEMPERATURE TYPES OF THE UNITED STATES*

By Robert De C. Ward
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In a broad study of the essential characteristics of temperature over an extended area such as that of the United States, the conventional "typical" diagrams showing the annual march of temperature at certain selected stations are not wholly satisfactory. Such curves illustrate conditions which are often representative of small districts only. They not infrequently emphasize somewhat too strongly the local controls and peculiarities at individual places. They inevitably become associated with the names of the particular stations whose conditions they represent and may thus fail to bring clearly before the mind the larger and more general conditions which characterize broad areas.

Composite Temperature Curves

In his own teaching of college students the writer has found it useful to employ, in addition to the temperature curves for individual stations, *composite* curves showing the annual march of temperature as illustrated by the mean monthly values summarized for a group of stations in the same general region or climatic province.

The following diagrams, here published for the first time, are used for purposes of instruction in the course on the climatology of the United States which has been given at Harvard during the past twenty years. Familiarity with these fundamental curves enables anyone to answer reasonable questions regarding the march of temperature in any part of the United States and also to name the climatic province in which an unknown station whose monthly temperatures are given is situated. These curves are constructed as follows. For each climatic province a representative series of stations is selected, ranging in number from ten to fifteen or twenty. In the majority of cases these are regular Weather Bureau stations, because they have the longest records and show conditions over the districts of densest population. Most of the places selected are fairly near sea evel, but in the western mountain and plateau districts several of them are

* This is the eighth in a series of articles by the present writer on the climatology of the United States. The previous articles were: Climatic Subdivisions of the United States, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 672–680; Rainfall Types of the United States, *Geogr. Rev.*, Vol. 4, 1917, pp. 131–144; Rainy Days and Rain Probability in the United States, Vol. 7, 1919, pp. 44–48; Frost in the United States, *Geogr. Rev.*, Vol. 7, 1919, pp. 339–344; Cloudiness in the United States, *Geogr. Rev.*, Vol. 9, 1920, pp. 347–356; New Monthly and Seasonal Rainfall Maps of the United States, *Geogr. Rev.*, Vol. 10, pp. 173–181; A New Series of Sunshine Maps of the United States, *Geogr. Rev.*, Vol. 10, pp. 339–341.

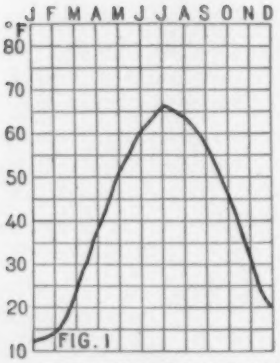
5,000 or more feet in elevation. In addition, the data for certain co-operative stations with long records are included, in order that the temperature in localities where there are no regular Weather Bureau stations may have representation. Altitudes above those of considerable human settlement are, however, not taken into account. More co-operative observers' records are used in the west than in the east. The data have not been reduced to a uniform basic period. Such reduction is unnecessary when observations for several stations, at various altitudes and with diverse topographic environment, are included in one general summary. The data employed are the latest and best available.

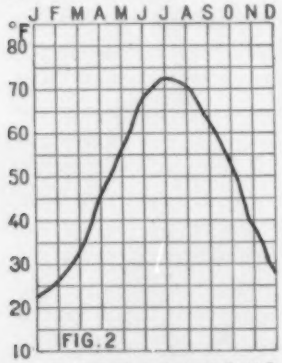
Purpose of the Composite Curves

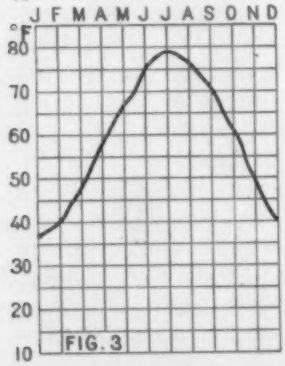
Composite curves of the kind here given are very satisfactory for the purpose for which they are intended to be and have been employed, i.e. to bring out the larger facts of temperature over considerable areas. The objection that these curves do not illustrate the actual conditions at any place and that they are therefore simply a "hodgepodge," is not valid when the specific purpose of the diagrams is considered. They are not intended to show the exact temperatures at any station. If it were desired to illustrate, e.g., the local conditions on mountains, in valleys, by the sea, around the Great Lakes, etc., an almost indefinite number of curves would be needed which, however interesting and important in themselves, would not be useful in any general study which must be completed within a limited time. Anyone who seeks such specific and exact information can find it in the very complete tabulations of data in *Bulletin W* and in other publications of the Weather Bureau. In *Bulletin W* the data for most of the 106 "sections" are grouped according to the natural topographic or other subdivisions (usually three or four) of each section. If a curve were drawn for each subdivision of all of the 106 sections, it can readily be seen that the number of such curves would run up to several hundred. The gain in simplicity which results from the use of a few composite curves such as those here given far more than offsets, in the opinion of the writer, the disadvantage that these curves do not represent any specific places. In the composites here given, representative data have been included for each of the more important subdivisions given in *Bulletin W*. This bulletin sets forth many facts of essential importance in any detailed study of temperature. The stations are grouped by counties as well as, in most cases, by climatic subdivisions; the altitudes are given, and a contour map for each section shows the exact location of each station and its general topographic surroundings.

Classroom Use

In the use of these composite curves in the classroom, the logical method is first to familiarize the students with the curve for each large climatic province, as an illustration of the general conditions, and then to indicate,







FIGS. 1–12—Annual march of temperature by months for the climatic provinces of the United States.

FIG. 1—Eastern province, northern tier. Mean annual 40° ±; range 55° ±.

FIG. 2—Eastern province, central tier. Mean annual 50° −; range 50° −.

FIG. 3—Eastern province, southern tier. Mean annual 60° −; range 40° +.

verbally or by means of numerical data, how the conditions in the north and south, or on the mountains, or near the sea, differ from the composite. By following such a method the number of general temperature types remains relatively small and yet serves as the foundation upon which variations from the composite may be built up. The composite is the pattern. The departures from it are embroideries upon that pattern. It is important that all the curves be plotted on the same scale, and on co-ordinate paper slips of uniform size. By this method the differences in the monthly and annual temperatures themselves, and also the differences in the amounts of mean annual range, are clearly seen, and the larger effects of land and water are emphasized.

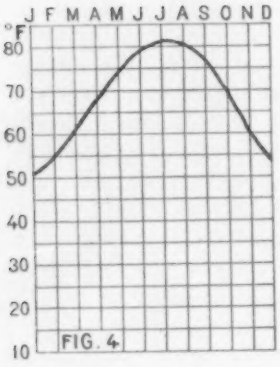
The Eastern Province

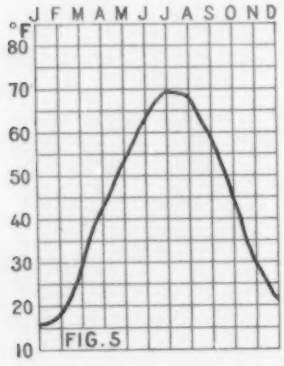
The Eastern climatic province extends from the Great Plains eastward to the Atlantic and southward to the section bordering on the Gulf of Mexico. Latitude, not altitude, is the fundamental control of temperature. Hence it is both logical and convenient, for the present purpose, to give three composite curves for this province, each curve representing an east-west belt of about 5° of latitude in width. The first of these (Fig. 1) is for the (a) *northern tier*, north of latitude 45° N., which extends from eastern North Dakota (including northeastern South Dakota) eastward across Minnesota and then across the northern portions of Wisconsin, Michigan, and New England. The second (Fig. 2) is for the (b) *central tier* of states, between latitudes 40° and 45°, lying between the eastern margin of the Great Plains and the Atlantic. The third (Fig. 3) is for the belt between latitude 40° on the north and the Gulf province on the south, and extends from the Great Plains to the Atlantic. This may be called the (c) *southern tier*.

Figures 1, 2, and 3 may best be considered together. The mean annual temperatures and the mean annual ranges are given in round numbers

below the curves. All three curves are distinctly continental in character. January and July are the coldest and warmest months respectively, and the annual ranges are large. From north to south the (composite) mean annual temperatures increase from about 40° to slightly below 60°, which is at the rate of about 10° for 5° of latitude, and the (composite) mean annual ranges decrease from about 55° to slightly over 40°. The increasing mildness of the winters and the increasing heat of the summers from north to south also appear distinctly in the differences in the position of the three curves on the co-ordinate base. From the fact that each of the three "tiers" covers a range of 5° (in the northern tier it is 5°−; in the southern tier it is 5°+) it follows that the northern stations will have colder winters and lower mean annual temperatures than the stations in more southern latitudes in the same tier. Thus the January means at the northernmost stations are in some cases as much as 10° (more or less) lower than those shown in the curves, and the southernmost January means are higher than those of the curves by the same amount or less.[1] Among the special characteristics which distinguish the temperature curves in different portions of the Eastern province, the following may be noted. It is a rather striking fact that the temperature conditions between the middle or even the western portions of the individual belts do not differ very greatly from those in the east, in spite of the considerable longitudinal extent of the belts. The reason is found in the fact that, chiefly under the control of the prevailing winds, the continental climate of the interior reaches the Atlantic Ocean. It is true, as has been pointed out, that the winters of the northernmost interior are colder than those farther south in the same belt; but if we take a belt of country like that between Chicago and Boston, for example, which the writer has for convenience described as the "New York Central belt," it is found that the mean annual and the mean monthly temperatures are essentially the same all along this belt. If a class of students be given the monthly means for Chicago, Cleveland, Albany, and Boston, e.g., without any indication of the names or the location of these four stations, it will, at any rate in the earlier stages of such a study, be found difficult if not impossible for the individual members of the class to determine whether the particular station in question is in New England or in New York or as far west as Chicago. Increasing familiarity with temperatures will, however, soon lead a class to distinguish between the somewhat colder winters of the farther western stations and the slightly milder winters on the Atlantic coast. Another special modification of the composite curves shown in Figures 1 and 2 appears around the Great Lakes, where "marine" influences at certain stations result in somewhat tempered winters and in a retarded minimum, February being either slightly colder than January or the two months having nearly the same mean temperature. A third modification, of a more local type, is seen in the cooling influence of the Atlantic Ocean

[1] "Northernmost" and "southernmost" refer to the most northern and most southern of the group of stations selected to make up the composite curve.





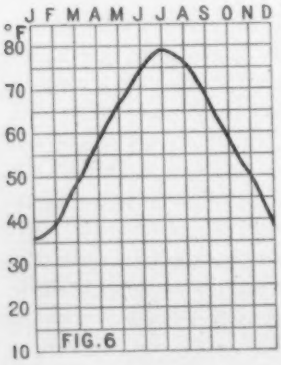


FIG. 4—Gulf province. Mean annual 70° −; range 30° ±.

FIG. 5—Northern Plains province. Mean annual 45° −; range 55° −.

FIG. 6—Southern Plains province. Mean annual 55°–60°; range 40° +.

at certain coast stations during midsummer. The coast of Maine is especially favored in this respect. Again, the modifying influence of altitude may be seen in the annual march of temperature at many stations scattered throughout the Appalachian area, from New England southward.

THE GULF PROVINCE

Figure 4, which gives the composite curve for the districts bordering on the Gulf of Mexico and on the adjacent portion of the Atlantic (Gulf province), should be taken as part of the sequence already discussed in the preceding paragraphs.

The Gulf province is, obviously, only a fourth—the southernmost—tier of the Eastern province taken as a whole. From north to south the mean annual temperatures of these four belts are seen to increase about 10° from one tier to the next. The Gulf province thus has a composite mean annual of slightly below 70°. Its range is also about 10° less than that shown in Figure 3. The increasing mildness of the southern winters (individual January means are slightly over or under 50°) and the somewhat higher summer temperatures (July and August means are usually within a degree or so of 80°) are characteristic features. It will also be noted that August differs less from July than is the case in the preceding composites. The prevalence of on-shore winds along the southern coast during the summer months, together with the resulting partial marine control, doubtless explains this condition.

THE PLAINS PROVINCE

The climate of the Great Plains differs from that of the eastern United States in rainfall rather than in temperature. The temperatures are here illustrated by two composite curves, one for the Northern and one for the Southern Plains. The line of division between the two roughly follows latitude 40°. Figure 5 shows the conditions based upon the data for a number

of stations in Montana, eastern Wyoming, and the western portions of the two Dakotas and of Nebraska.

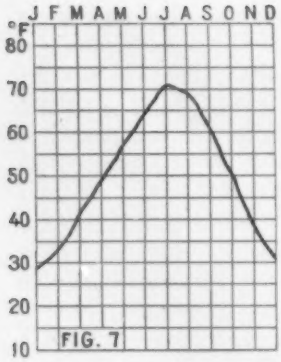
Figure 5 is very similar to Figure 1 but has slightly warmer summers, the composite mean annual range, expressed in round numbers, being about the same. At the Northern Plains stations, however, e.g. in North Dakota, the ranges are larger (over 60°) and the January means are 10° or so lower than those of the composite. At other stations, especially those farther south, the midwinter means are 5° or so above the composite means. There is, also, a variation of 5°–10° in the mean annual temperatures, according to the location of the individual stations. The rapid rise of temperature in spring, the fairly close similarity of the July and August means, and the rapid fall after the heat of the summer is over are noticeable. The warm summers of this great interior region of cold winters are an important climatic asset in relation to crop growth.

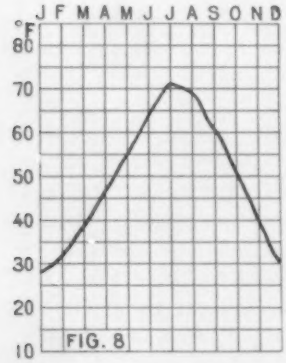
The Southern Plains (Fig. 6) have higher mean annual temperatures (55°–60° as against 45°−), smaller ranges (40°+ as against 55°−), much milder winters (warmer by about 15°–20° on the average in January), and somewhat warmer summers (July mean about 10° higher) than the Northern Plains. Comparing Figure 6 with Figure 4 (Gulf) it is seen that the latter has warmer winters, slightly warmer summers, and a smaller mean annual range. There is, however, naturally a very close correspondence between the Southern Plains province (Fig. 6) and the southern tier of the Eastern province (Fig. 3). The effect of latitude within the limits of the Southern Plains province is shown in the colder winters and lower mean annual temperatures at the northern stations. In the south, July means of 80° and slightly more occur.

The Plateau Province

The curves for the northern and southern portions of the Plateau province are necessarily based upon data from stations differing greatly in their topographic environment and altitude. Individual localities therefore show considerable departures from the general means shown in these diagrams. Into the details of such variations the present discussion cannot attempt to go. If a very rough generalization is desired, it may be stated that there may be a variation of 5°, plus or minus, in the annual, January, and July means from those shown in the composite. A comparison of Figure 7 with Figure 5 (Northern Plains) shows that the latter district, east of the Rocky Mountain barrier, has colder winters, lower mean annuals, and larger ranges, while the summers are practically the same. The central tier of the Eastern province (Fig. 2) has a very similar curve to that of Figure 7, but the latter has milder winters and a smaller range.

The Southern Plateau province includes so great a range of latitude (nearly 10°) and so varied a topography that a single composite curve is of little significance. The more northern, and the higher, stations differ greatly from those on the low-lying deserts to the south in the summer "heat





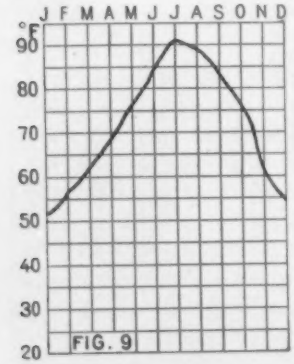


FIG. 7—Northern Plateau province. Mean annual 50°+; range 40°+.

FIG. 8—Southern Plateau province. Mean annual 50°±; range 40°+.

FIG. 9—Southern Plateau (southern desert lowlands) province. Mean annual 70°+; range 40°−.

island" of this interior region. The data used in the construction of Figure 8 do not include the latter group of stations. It is at once seen that Figures 7 and 8 are practically identical, as is to be expected when Figure 8 includes only such stations as are in the northern portion of the Southern Plateau and at considerable altitudes. This general fact is worth bringing out. There are stations over the Plateau whose mean annual and mean monthly temperatures are very similar to those of stations in the central tier of the Eastern province, but the other climatic characteristics are quite different.

Stations in the low-lying and arid "heat island" of southern Arizona have quite a different temperature curve from the composite of Figure 8. Figure 9 is based on the data for certain well-known and representative stations in southern Arizona. (In this diagram, the scale is the same as in the other figures, but the position of the individual temperature readings on the co-ordinate paper has been changed in order to accommodate the higher summer means.) The winters on the southern "deserts" are decidedly milder and the summers hotter than is the case at the stations situated in the north and on the elevated plateaus. Thus, the mean annual temperatures at the southern localities are about 70°, and the July means reach and even slightly exceed 90°. There is little likelihood of confusing the temperatures in southern Arizona with those of the Gulf province (Fig. 4). The former has distinctly hotter summers, although the annual means are more or less the same.

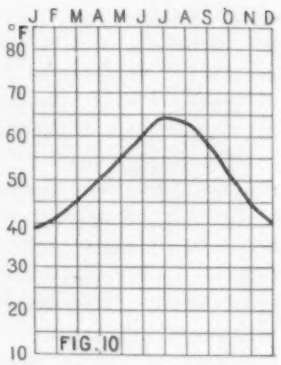
THE PACIFIC PROVINCE

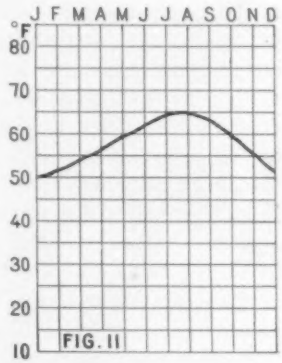
For the purpose of the present discussion the Pacific slope is conveniently subdivided into (1) Northern and (2) Southern Pacific provinces, and the latter into (a) coast and (b) interior valley. Many other local peculiarities of temperature distribution would appear if further subdivision were attempted, but the resulting

increase in the number of composite curves would offset the object which the writer has in mind.

The curve for the Northern Pacific province (Fig. 10) is based upon data for the coast, the Puget Sound region, and the interior valleys. In the north, the temperatures in the longitudinal valleys do not differ as much from those of the coast and of the Sound as do those of the Sacramento-San Joaquin valley, farther south, from the temperatures of the southern coast stations. Hence, it does not seem necessary, in a very general consideration such as that in hand, to make more than one curve for the Northern Pacific climatic province. The summers of the interior valleys, e. g. especially in southern portions of Oregon, are, however, naturally warmer by several degrees than those of stations like Seattle or Tacoma. The composite curve (Fig. 10) at once shows the marine influence on a windward coast. The winters are milder than those shown on any of the preceding curves except in the Gulf province (Fig. 4) and on the desert lowlands of southern Arizona (Fig. 9) but are not unlike those of the southern tier of the Eastern province (Fig. 3) and of the Southern Plains (Fig. 6) so far as the mean temperatures alone are concerned. The summers average cooler than those in any of the preceding curves, even than those of the northern tier of states in the Eastern province (Fig. 1). The range (about 25° only) clearly indicates the equability of the Pacific slope climates. The departures, at individual stations, of the annual and of the January means from those shown on the curve are too small to call for comment. The July means differ by roughly about +5° (in the southern interior valley of Oregon) to about −5° (on the extreme northwestern coast).

A composite of the Southern Pacific coast conditions is given in Figure 11. The stations included in the composite are nearly all south of San Francisco. Here are the most equable temperatures shown in any of the curves. The





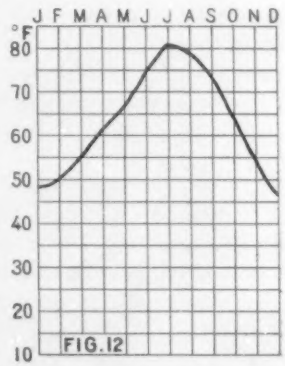


FIG. 10—Northern Pacific province. Mean annual 50°+; range 25°±.

FIG. 11—Southern Pacific (coast) province. Mean annual 55°–60°; range 15°.

FIG. 12—Southern Pacific (interior) province. Mean annual 60°–65°; range 35°±.

range is only about 15°, and the monthly means are all included between 50° and 65°. The retardation of the maximum into August is seen at several, although not at all, of the coast stations and is sufficiently frequent to appear on the composite. This is distinctly a marine characteristic. On the extreme northern coast of California the mean annual temperature is a few degrees lower than that of the composite curve, and on the extreme southern coast it is about the same amount above the general mean.

Figure 12 is based on the data from about a dozen stations in the Sacramento-San Joaquin valleys. It is not unlike that for the Gulf province (Fig. 4); but the mean annual temperature is higher, and the range is smaller in the latter. The July means in the California valley are higher than those seen in any other curve except that for the Gulf (Fig. 4) and that for the "heat island" (Fig. 9) but are only slightly above those of the southern tier of the Eastern province (Fig. 3). A natural comparison is that between the coast and the interior of California (Figs. 11 and 12). The continental controls in the latter are obvious. In the interior July is the warmest month, as contrasted with the (frequently) retarded maximum in August on the coast. The winters are milder on the coast, and the summers decidedly cooler. Hence the mean annual range in Figure 12 is decidedly greater (by about 20°) than that in Figure 11. The Northern Pacific coast winters (Fig. 10) are not quite as mild as those of the California valley, as is to be expected from the higher latitudes and other controls in the former case; but the summers of the Northern Pacific are decidedly cooler than those of the southern interior valleys. In spite of the great extent of the California valley in a north-south line, the temperatures are remarkably uniform throughout the district. The maximum departures from the composite means are somewhat less than + 5° at the southern stations in July. The foothills of the Sierra Nevada have their own type of temperature curve, their cooler summers as compared with those on the valley floor being a valuable asset in the popularity of that district for summer outings.

Conclusion

In conclusion it may not be inappropriate for the writer to state what, in his experience, has proved to be an effective way to fix in the minds of students the essential facts regarding the temperatures of the United States. The stages in the successive laboratory exercises on this subject are as follows:

1. A study of the larger world relations of the sea-level temperatures over North America, based on the *Challenger* isothermal maps.

2. A critical comparative study of the advantages and disadvantages of sea-level and of actual temperature charts for the United States, based on various maps, e.g. those of the *Challenger* series, of Hann, of the Weather Bureau, of Herbertson, and of others.

3. The students are given, in three weekly exercises, the mean monthly

temperatures at certain selected stations whose location is unknown to them. These temperatures are plotted by each member of the class on co-ordinate paper slips similar to those used in the present discussion, and then each student indicates, as well as he can, the probable location of each station. The material used in working out these locations is that which is already familiar through the preceding exercises. When each student has located the stations to the best of his ability, the names and exact locations are given. The curves are then attached, by means of paper fasteners, to a large wall outline map of the United States, mounted on a soft-pine frame to which it is fastened by thumb tacks. The students put the curves onto the outline map themselves, and a stimulating rivalry is created by the teacher's selecting those curves which are most neatly and most accurately plotted for use on the wall map. When all the curves have been plotted and fastened to the outline map, the latter is uniformly covered, and the temperatures over all parts of the country can be further compared and memorized. The whole exercise never fails to interest the class, and while it is in progress there is always much animated discussion as to the probable location of the different stations whose monthly temperatures have been given.

4. The composite curves included in the present paper are used, at the end of the laboratory exercises just described, for the purpose of summarizing, in a very broad and general way, the essential facts of the distribution and characteristics of the temperatures in the different climatic provinces of the United States.

THE EVOLUTION OF CLIMATE IN NORTH-WESTERN EUROPE: A REVIEW*

By Ellsworth Huntington

Yale University

During the last few years Mr. C. E. P. Brooks has published a number of important papers on changes of climate. In the article under review he gives an admirable summary of the main climatic pulsations from the height of the glacial period to the time of Christ. His climatic table, based on his article in the annual report of the Smithsonian Institution for 1917,[1] is as follows:

Phase	Climate	Date
1. Last Great Glaciation	Arctic	30,000–18,000 B.C.
2. Retreat of the Glaciers	Severe continental	18,000–6000 B.C.
3. Continental	Continental	6000–4000 B.C.
4. Maritime	Warm and moist	4000–3000 B.C.
5. Later Forest	Warm and dry	3000–1800 B.C.
6. Peat-Bog	Cooler and moister	1800 B.C.–300 A.D.
7. Recent	Becoming drier	300 A.D.—

This table needs amplification. Mr. Brooks bases his chronology largely on Gerard De Geer's measurements of the annual layers of clay in lake bottoms but makes much use of other evidence. According to Brooks, the last glacial epoch lasted roughly from 30,000 to 18,000 B.C.; but this includes a slight amelioration of climate followed by a readvance of the ice, known as the Buhl stage. During the time of maximum glaciation the British Isles stood twenty or thirty feet higher than now, and Scandinavia was "considerably" more elevated. The author believes that this caused a fall of 1° C. in the temperature of the British Isles and of 2° C. in Scandinavia. By an ingenious though not wholly convincing method of calculation, which is explained in previous publications, the author concludes that this increase of temperature aided by an increase in the area of the lands sufficed to start an ice sheet in Scandinavia. The ice area, though relatively small in extent, cooled the air and gave rise to an area of high barometric pressure. This in turn is supposed to have caused further expansion of the ice and thus to have led to full-fledged glaciation.

About 18,000 B.C. the retreat of the ice began in good earnest. Even though no evidence has yet been found, Brooks believes there must have

* C. E. P. Brooks: The Evolution of Climate in North-West Europe, *Quart. Journ. Royal Meteorol. Soc.*, No. 199, Vol. 47, 1921, pp. 173–194, London.

[1] C. E. P. Brooks: The Correlation of the Quaternary Deposits of the British Isles with those of the Continent of Europe, *Ann. Rept. Smithsonian Instn.* for 1917, pp. 277–375.

been some change in the distribution of land and sea to account for the diminution of the ice. The ensuing millenniums formed the Magdalenian period in human history, the last stage of the Paleolithic, when man lived in caves and reindeer were abundant in central Europe.

The Retreat of the Glaciers

At first the ice retreated very slowly, and there were periods when for scores of years the ice edge remained stationary or even readvanced. About 10,000 B.C. the edge of the ice lay along the southern coast of Sweden. During the next 2,000 years it withdrew more rapidly to about 59° N. Then came the Fennoscandian pause, or Gschnitz stage, when for about 200 years the ice edge remained in one position, forming a great moraine. Brooks suggests that this pause, about 8000 B.C., was due to the closing of the connection between the Atlantic Ocean and the Baltic Sea and the synchronous opening of a connection between the Baltic and the White Seas, whereby cold Arctic waters replaced the warmer Atlantic waters. He notes, however, that about 7500 B.C. the obliquity of the ecliptic was probably nearly 1° greater than at present. This he calculates to have caused the climate of Germany and Sweden to be 1° F. colder than at present in winter and 1° F. warmer in summer.

The Continental Phase

The next climatic stage was marked by a rise of temperature till about 6000 B.C. During this period the ice at first retreated, presumably because the climate was ameliorating, although no cause of such amelioration is assigned. At length the ice lay far enough north to allow a connection between the Baltic and the Atlantic by way of Lakes Venern and Vettern in southern Sweden. This is supposed to have warmed the Baltic Sea and caused the climate to become distinctly milder. Next the land rose once more so that the Baltic was separated from the Atlantic and was converted into the Ancylus lake of fresh water. The southwestern Baltic region then stood 400 feet higher than now. The result was the Daun stage, about 5000 B.C., when the ice halted or perhaps readvanced a little, its front being then near Ragunda in about latitude 63°. Why such an elevation did not cause renewed glaciation, instead of merely the slight Daun pause, Brooks does not explain, although his calculations as to the effect of a slight elevation of the land during the main period of glaciation from 30,000 to 18,000 B.C. would seem to demand a marked readvance.

After 5000 B.C. there ensued a period when the climate, although still distinctly continental, was relatively mild. The winters, to be sure, were still cold, but the summers were increasingly warm. In Sweden, for example, the types of vegetation indicate that the summer temperature was 7° F. higher than now. Storms were comparatively rare except on the outer fringe of the British Isles. There they were sufficiently abundant so that in the

northwestern part of the islands they gave rise to the first Peat-Bog period, during which swamps replaced forests of birch and pine. Southern and eastern England, however, probably had a dry continental climate. Even in northwestern Norway storms were rare, as is indicated by remains of forests on islands now barren because of the strong winds and fierce storms. Further east most parts of central and northern Europe were relatively dry. This was the Early Neolithic period when man advanced from the use of unpolished to polished stone implements.

The Maritime Phase

Not far from 4000 B.C. the period of continental climate was replaced by a comparatively moist maritime climate. Brooks believes that this was because submergence opened the mouth of the Baltic and caused the fresh Ancylus lake to give place to the so-called Litorina sea. The temperature in Sweden averaged about 3° F. higher than at present, and in southwestern Norway 2°. More important than this was the small annual range of temperature, due to the fact that the summers were cool while the winters were mild. Because of the presence of a large body of water in the Baltic region, storms, as our author states, then crossed the British Isles and followed the Baltic depression, carrying the moisture far inland. In spite of the additional moisture thus available the snow line in southern Norway was higher than now.

At this point Brooks turns to other parts of the world. He states that not far from 4000 B.C. a submergence of the lands, rarely amounting to more than 25 feet, took place not only in the Baltic region but in Ireland, Iceland, Spitsbergen, and other parts of the Arctic Ocean, as well as in the White Sea, Greenland, and the eastern part of North America. Evidences of a mild climate are found in all those places. Similar evidence of a mild, warm climate is found in eastern Africa, eastern Australia, Tierra del Fuego, and Antarctica. The dates are not established with certainty, but they at least fall in the period immediately preceding the present epoch. In explanations of these conditions Brooks assumes a universal change of sea level. He suggests with some hesitation that this may have been due to one of O. Pettersson's periods of maximum "tide-generating force." According to Pettersson the varying positions of the moon, earth, and sun cause the tides to vary in cycles of about 9, 90, and 1,800 years, though the length of the periods is not constant. When tides are high there is great movement of ocean waters and hence a great mixture of the water in different latitudes. This is supposed to cause the amelioration of climate. The periods of maximum and minimum tide-generating force are as follows:

Maxima	3500 B.C.		2100 B.C.		350 B.C.		1434 A.D.
Minima		2800 B.C.		1200 B.C.		530 A.D.	

Brooks thinks that the big trees in California and the Norse sagas and Germanic myths indicate a rough agreement of climatic phenomena with

Pettersson's last three dates, while the mild climate of 4000 B.C. may really belong to 3500 B.C. He gives no evidence confirming Pettersson's view of the other three dates.

The Later Forest Phase

To return to our sketch of climatic pulsations, by 3000 B.C., that is toward the close of the Neolithic period, further elevation had taken place over the central latitudes of western Europe. Southern Britain, which had remained constantly above its present level ever since 30,000 B.C., was 90 feet higher than now. Ireland was somewhat enlarged by elevation, the Strait of Dover was almost closed, and parts of the North Sea were land. To these conditions Brooks ascribes the prevalence of a dry continental climate. The storms shifted northward once more, the winds were mild, as seems to be proved by remains of trees in exposed places, and forests replaced fields of peat and heath in Britain and Germany. The summers were perhaps warmer than now, but the winters were severe. The relatively dry climate prevailed as far west as Ireland. For example, in Drumkelin Bog in Donegal County a corded oak road and a two-story log cabin appear to belong to this time. Fourteen feet of bog lie below the floor and 26 above. This period, perhaps 3000–2000 B.C., was the legendary heroic age of Ireland when "the vigour of the Irish reached a level never since attained." This, as Brooks points out, may have been a result of the relatively dry climate, for today the extreme moisture of Ireland seems to be a distinct handicap. In Scandinavia civilization, or at least the stage of relative progress, was also high at this time.

The Peat-Bog Phase

By 1600 B.C. the land had been submerged to its present level in the British Isles and the southern Baltic region, while northern Scandinavia still stood lower than now. The climate of Britain and Germany was so humid that there was an extensive formation of peat even on high ground not before covered. This moist stage seems to have lasted almost to the time of Christ and may have been the reason why the Romans describe Britain as peculiarly wet and damp. At this point Brooks again departs from northwestern Europe to a wider field:

> It is possible that we have to attribute this damp period in North-West Europe to some more general cause, for Ellsworth Huntington's curves of tree-growth in California and climate in Western Asia both show moister conditions from about 1000 B.C. to A.D. 200, and the same author believes that the Mediterranean lands had a heavier rainfall about 500 B.C. to A.D. 200. It seems that the phase was marked by a general increase of the storminess of the temperate regions of the northern hemisphere at least, with a maximum between Ireland and North Germany, indicating probably that the Baltic again became the favourite track of depressions from the Atlantic.

Postglacial Changes in North America

Mr. Brooks ends his paper with a brief résumé of postglacial changes in North America; but, as the means of dating events are unreliable, the degree

of synchronism with Europe is not clear. He sums up his conclusions as follows:

> On the whole it appears that though there is a general similarity in the climatic history of the two sides of the North Atlantic, the changes are not really contemporaneous, and such relationship as appears is due mainly to the natural similarity in the geographical history of two regions both recovering from an Ice Age, and only very partially to world-wide pulsations of climate. Additional evidence on this head will be available when Baron de Geer publishes the results of his recent investigations of the seasonal glacial clays of North America, especially if, as he hopes, he is able to correlate the banding of these clays with the growth-rings of the big trees.
>
> When we turn to the north-west of North America, this is brought out very markedly. For in Yukon and Alaska the Ice Age was a very mild affair compared with its severity in eastern America and Scandinavia. As the land had not a heavy ice-load to recover from, there were no complicated geographical changes. Also, there were no fluctuations of climate, but simply a gradual passage to present conditions. The latter circumstance especially seems to show that the emphasis laid on geographical rather than astronomical factors of *great* climatic changes is not misplaced.

Mr. Brooks's painstaking discussion of postglacial climatic changes is of great value because of the large body of material which he has so carefully wrought together. His strong belief in the importance of changes in the level of the lands deserves serious consideration. It is difficult, however, to accept his final conclusion that such changes are the main factors in *great* climatic changes. It is almost impossible, for example, to believe that movements of the land could produce almost the same series of climatic changes in Europe, Central Asia, the western and eastern parts of North America, and the southern hemisphere. Yet that is what appears to have happened during and since the glacial period. Again, there is no evidence whatever that movements of the land have anything to do with the historic cycles of climate or with the cycles of weather in our own day, which seem to be the same as climatic cycles on a small scale. Also, as Dr. G. C. Simpson points out in the discussion of Mr. Brooks's paper before the Royal Meteorological Society, there appears "no solution along these lines of the problem connected with rich vegetation in both polar circles and the ice-age which produced the ice-sheet at sea-level in Northern India." We may well believe that Mr. Brooks is right in holding that changes in the relative level and relative area of land and sea have had important local effects. His appeal to astronomical causes is not really a sign of weakness in his own theory, as was suggested in the discussion. It is merely a sign that so complicated a natural phenomenon as climatic changes cannot be explained by any one theory. While changes in the level of the lands may not be the main cause, they are certainly a contributory cause which cannot be neglected.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Meetings of November and Elections to Fellowship. The first regular monthly meeting of the American Geographical Society for the season of 1921-1922 was held on November 22 at the Engineering Societies' Building, 29 West Thirty-ninth Street. President Greenough presided. There were presented with the approval of the Council the names of 384 candidates who were duly elected as Fellows of the Society. Thereupon the Society was addressed by Professor Henry E. Crampton on "Guam, Siam, and Java—Three Representative Countries of the Far East." In this well-illustrated lecture Professor Crampton described his sixth journey in the Pacific Islands, the latest of eleven journeys in the tropics.

A special illustrated lecture on "Present-day China" by Mr. J. O. P. Bland was given on November 10 at the Society's Building, Broadway at 156th Street. Mr. Bland was for many years associated with the Chinese government and is well known as the author of several standard works on China. He made an earnest plea for the support of China that the country's unique civilization might continue to develop along native lines.

Distribution of Title Page, Contents, and Index of Volume 11 of the "Geographical Review." The title page, table of contents, and index for Volume 11 of the *Geographical Review* (1921), which is issued separately, is ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

NORTH AMERICA

Canada's Boundaries. "The Unguarded Boundary," an address by Ambassador John W. Davis as President of the Birmingham and Midland Institute of Great Britain for 1920, recalls the satisfactory condition of affairs respecting the boundary between the United States and Canada. The amicable settlement of this international boundary may be regarded as a great achievement in view of the length of line—5,400 miles—and the variety of natural conditions encountered and the variety of conflicting claims invited thereby. These conditions are graphically sketched by Ambassador Davis in recounting the romance of the early days of the frontier and the history of the subsequent boundary negotiations beginning with the treaty of 1783 and terminating with the decision of the Alaskan tribunal in 1903.

The work of surveying, defining, and marking the boundary is nearing an end. Surveying of the southern boundary is practically completed, and the maps are being made upon which the commissioners lay down the line in its final position. In certain sections, particularly from the Lake of the Woods to Lake Superior, along Hall's Stream (a headwater stream of the Connecticut River), St. Francis River, and the line from the source of the St. Croix River to Passamaquoddy Bay, the final determination remains to be made, but it is not anticipated that any serious differences will arise. As regards the boundary between Alaska and Canada the section along the 141st meridian, that is from the Arctic Ocean to Mt. St. Elias, has been demarcated (Report and Atlas published in 1918); and the "natural" boundary from Mt. St. Elias to Cape Muzon, the southern extremity, has been laid down and agreed upon, and reports and maps are in preparation.

The Dominion, however, has a boundary question on its hands in the dispute with Newfoundland over Labrador. Since 1763, with a lapse between 1774 and 1809, Newfoundland has had jurisdiction over a portion of the "coast" of Labrador (James White: Boundary Disputes and Treaties, Toronto, 1914). The wording of the Labrador Act of 1825, which was supposed to be definitive, is obscure. All that the Act established beyond question was the short stretch of boundary due north from Blanc Sablon to the 52nd parallel. Northward, indeed, there was no immediate practical need for settlement; interest in the region was confined to the seaboard frequented by Newfoundland fishermen. Recently, however, attention has been called to the lumbering possibilities of the interior, which have been

proved to be considerable, and to the possibilities of mineral resources which remain to be investigated. Development is precluded until land titles are assured, and this awaits settlement of the boundary issue. Quebec, which since 1912 has included all the remaining portion of the peninsula, claims the limitation of Newfoundland to a narrow coastal strip. Newfoundland makes claim to a considerable hinterland, including the timberlands of the Hamilton River basin. A commission is now at work on the problem (*Current History*, New York Times, February, 1921, pp. 264–265). It is suggested that an ultimate result of the case will be inclusion of Newfoundland in the Dominion of Canada.

SOUTH AMERICA

Memorial to James Orton on Lake Titicaca. On the shores of Lake Titicaca on September 25 of last year there was unveiled a memorial to James Orton, one of the group of American explorers, who in the latter half of the last century made material contribution to our knowledge of the upper Amazon basin (*West Coast Leader*, Sept. 17 and Oct. 1, 1921). On his first expedition (1867) Professor Orton crossed the Ecuadorean Andes and descended the Napo. One of the results was "The Andes and the Amazon" (1870), a volume that went into three editions. The third edition also included notes on a second journey in 1873 up the Amazon to Yurimáguas on the Huallaga and thence over the Andes. In 1876 Professor Orton organized a third expedition with the object of exploring the Beni. On this he was accompanied by Ivon Heath, brother of Edwin Heath who a few years later made a successful exploration of that river. The party proceeded via Cochabamba and Trinidad to within 25 miles of the confluence of the Beni, where in consequence of a mutiny by the Indians of the party their plans were abandoned. They turned back up the Mamoré to Exaltación and thence across the pampas to Reyes and over the Andes by Apolobamba, an exhausting journey of 600 miles. To the hardships encountered Professor Orton succumbed while crossing Lake Titicaca. He was buried on Esteves Island, a rocky islet in the Bay of Puno. It is here that the memorial, a monument of New Hampshire granite in the form of the ancient Inca burial towers, has been erected. It was contributed by the Alumnæ Association of Vassar College, where Orton was professor of natural history at the time of his death. Presentation was made to the Peruvian Government by a delegation from the Association at a ceremony attended by members of the diplomatic corps and representatives of scientific and educational institutions.

EUROPE

The Economic Geography of Northern Sweden. Northern Sweden (Norrland) has an area of some 100,000 square miles—60 per cent that of Sweden as a whole—and a population a little over 1,000,000, that is 18 per cent of the total population of the country. Small as this figure is it represents a great relative gain on that of a half-century ago, a gain furnished in part by a relatively great natural increase and in part by immigration from more southerly regions. This movement of the population follows on industrialization of the region, a process described in detailed and well-illustrated fashion by H. W. Ahlmann in a recent number of *Geografiska Annaler* (Vol. 3, Parts 1 and 2, 1921, pp. 96–162). Figures showing the occupational distribution of the population, while only approximate, are significant of the change. For the southernmost district of Norrland (Gävleborg) percentages of population engaged in farming, forestry, and allied occupations; in mining and manufacturing; and in trade communications respectively were 79, 11, and 2 in the year 1840; while they were 44, 38, and 13 in 1910. For the northernmost district (Norrbotten) the figures are 89, 4, and 1 for 1840; and 60, 25, and 10 for 1910. (Compare the notes and see the maps on regional divisions of Norway in *Geogr. Rev.*, January, 1921, pp. 143–145.)

As regards economic development Norrland suffers under the handicap of its far-northern situation, involving relative inaccessibility and severe climate, and its unfavorable surface, presenting vast expanses of bare Archean rock. Its assets lie in its forests, its waterways, water-power resources, and iron-ore deposits. The forests are the greatest asset. Economic transformation of Norrland began with transformation of forest economy based on the introduction of steam sawmills in the sixties of the nineteenth century. Development of the lumber industries strengthened the already pronounced discrepancies of regional population distribution. The sawmills were placed at the river mouths, or rather on the bays beyond the river deltas or on the inner shores of the fringing islands, provided with

sheltered fairways, good harbors, and sufficient space. Lumber is easily floated down from the interior to the coast. It is estimated that there is 1 kilometer of waterway suitable for floating logs to 9.5 square kilometers of surface and that the average maximum distance for the hauling of logs is no more than 7 or 8 kilometers. Woodworking industries are thus concentrated on the seaboard, save charcoal burning and the associated production of tar and turpentine, which remain in the forests. The scanty population of the great Archean plateau is reflected in the bare one per cent of its surface under cultivation. The eastern plain has 66 per cent of the population and 80 per cent of the town dwellers. Round the sawmills of the Sundsvall district there are 600 to 800 people per square kilometer (1,550 to 2,000 per square mile). Sundsvall itself is a center of 16,861. To the new settlements on the outer border of the coastal plain the old towns, usually situated some distance up the river, act as administrative and trade centers.

The growth of population dependent on the present phase of forestry exploitation terminated a decade or so ago. Since 1900 the movement of migration has been reversed, many thousands of people leaving Norrland. The population of the sawmill districts of Sundsvall has declined, and so has that of several rural districts adjacent to industrial areas. In spite of the addition of the pulp industry in the last decade (it was earlier in southern Sweden), production and export of lumber has increased little since 1900. From large areas the first forest crop has been taken. Modern sawmills, furthermore, need fewer hands in proportion to the output. Future of the lumbering industries is dependent largely on the adoption of a rational system of forestry management. Attention should be paid to development of the charcoal industry, of importance in relation to the iron industry of the north: it would further tend to an increased population in the forest areas.

Future economic expansion is also dependent on utilization of the hydro-electric resources of the region. Out of a total of 5 to 6 million horse power for all Sweden, upper Norrland has 2,400,000 horse power, and lower Norrland with Dalarne 2,500,000. Of the latter 15 per cent has been developed, only 7 per cent of the former. There is hope of establishing such electrometallurgical and electrochemical industries as have been established in the French Alps. In the extreme north of Norrland, in latitude 67°–68° N., are the valuable iron-ore deposits of Kiruna and Gällivara which up to the present time have been exported in the raw state.

Economic expansion will be further conditioned by improvement in communications. Raw materials collected in the interior and brought down the northwest-southeast-trending valleys are concentrated at the river mouths to be sent by sea, the great highway of Norrland trade both import and export. Of the export trade (chiefly iron ore and lumber and other forest products) about 33 per cent is across the Norwegian border, less than 2 per cent by rail southwards, the rest by sea. Of the import trade (chiefly wheat and coal) about 3 per cent is across the Norwegian border, 7 per cent by rail from the south, the rest by sea. Yet navigation is suspended for several months during the winter. It should be made continuous or at least extended by the use of ice breakers, as is done on the eastern shores of the Bothnian Gulf, at Hangö, for instance.

With the exception of the ore railroads of the north, the railroads of Norrland have been of comparatively slight importance. There is, however, now under projection the Inland Railway which will connect the far north with an ice-free port in Swedish territory (in Göteborg). It will traverse the eastern border of the lake zone. Electrification of the railroads is also proposed.

It is hardly likely that there will be any great agricultural expansion as an independent movement, though completion of the Inland Railway will encourage farming in the richer lands of the interior, the "Silurian" zone of limestone soils and the lake zones with their alluvial patches. Agricultural expansion, however, is likely to accompany industrial expansion. At present agriculture is concentrated about the mouths and lower parts of the rivers, but even in the coast region only one-fifth of the land estimated cultivable is in use.

Racial Composition of the Population in Northern Norway. A not uncommon misconception that northern Norway is populated mainly by Lapps and Finns has led the Norwegian Central Bureau of Statistics to issue a pamphlet setting forth the numbers and distribution of the racial elements in this region (Befolkningsforholdene i Nord-Norge med saerlighensyn til nasjonalitet, Christiania, 1920). A table showing population according to the census of 1910 is accompanied by a map on the scale of 1:1,000,000 showing population of communes and prefectures by circles of area proportional to population (1 square milli-

meter representing 10 persons). The circles are colored according to race—Norwegian, Lapp, Finn. The map, it may be noted, has been prepared by the Inspector of the reindeer pastures for the Ministry of Agriculture and, while exact representation is always difficult in a region of mixed population, is believed to be as accurate as possible.

The whole of northern Norway had a population of 280,785 in 1910, of whom 6.5 per cent were Lapps and 2.8 per cent Finns. In the northeasternmost prefecture, Finmark, Lapps formed 26.4 per cent and Finns 13.3 per cent of the population. Only in a few small districts, mainly inland, was there a Lapp majority. In the southwestern prefecture (Nordland) Lapps numbered 1.1 per cent and Finns less than .1 per cent. Norwegians, furthermore, are increasing both absolutely and relatively. There is a well-marked migration into the north from more southerly regions.

There is a similarly small proportion of Finns and Lapps in northernmost Sweden. Lapps in Norrland numbered 7,000 in 1910 and Finns 24,770 out of a population of over 1,000,000 (see note above). In both instances they form an altogether strange element in the occupation of the land. A number of the Lapps are nomadic, and their movements provoke the usual troubles that rise between settled and migratory peoples. The Lapp reindeer damage the hay of the Swedish farmer. More seriously, international disputes arise. The nomads are not respecters of boundaries; their pasture lands extend indifferently across the frontier. Some few years ago commissions were appointed to settle the international difficulties, and in 1920 a reindeer pasture convention was made between Sweden and Norway.

AFRICA

The Political Geography of Italian North Africa. About a hundred years ago the founder of the Senussi confraternity, one of many that sprang to life within the Mohammedan world, withdrew from the Europeanized sections of the coast and established himself in an isolated and remote portion of the Sahara, the hinterland of Cyrenaica. Thence his power and that of his successors spread through a large section of the desert and even beyond its southern border. Established eventually in the oases of Kufara which became the center and capital of the Senussi realm, the Senussi leaders exercised a wide and profound influence. The trans-Saharan trade not only passed through the heart of their territory, it was fostered and welcomed. Free hospitality was offered any traveler for a period of three days. Moreover, the oases of Kufara are virtually self-supporting and are protected by a one-hundred-mile belt of sand dunes and by a still wider stretch of all but waterless desert. The geography of the region is admirably adapted to the support of one of the prime conditions of the founder that his people should keep away from the centers of civilization and unite various Bedouin tribes in one great religious organization.

If we have this picture before us and if we also appreciate the sinister reputation which the Senussi had among Europeans for a half century, we are prepared to understand the very extraordinary change of situation that has been brought about by Italy within the past few years. Sayed Idris, the head of the Senussi, has visited Rome; and he has made a treaty with Italy! He has been given the hereditary title of Emir and is the acknowledged independent ruler *on behalf of Italy* over the oases of Kufara, Jaghabub, Jalo, Aujila, and Jedabiya.

This vital change of policy on the part of the Senussi may affect the whole Mohammedan world, for Libya has been recognized for the past half century and more, as a critical area in the struggle of Moslem against Christian, with the Moslem situated in the desert whence war was waged against an European population on the coast. The struggle was long continued though fitful until 1911, when, in the Turco-Italian War, Italy pushed her frontier across the Mediterranean and established herself upon the northern coast of Africa; and thus the power of Rome once more claimed a long abandoned portion of the empire of the Cæsars. A war with the Senussi was inevitable and continued through the World War. The weakness of Senussi power was rather definitely revealed when Senussi troops attempted to invade Egypt. The British defeated the Senussi forces in February, 1917, at the oasis of Siwa, and since that time Italy's path has been easier. Finally, in November 1920, by the accord of Regima, the Italian government and the Senussi ratified the so-called Italo-British Agreement. This agreement was made between the British and Italian governments, on the one hand, and Sayed Idris as the head of the Senussi on the other.

By the terms of the agreement the Italian government will retain the coast towns and certain posts it now occupies a short distance inland, but it will create no new posts. The

Italian government also maintains courts and schools, pays monthly allowances to certain members of the Senussi in addition to supplying them with arms, ammunition, equipment, and food up to the amount required for four thousand men. The purpose of the last stipulation is to enable the Senussi to maintain public security in the interior of Cyrenaica. On their part the Senussi agree to maintain peace in the interior, to disarm the population, to form no new military posts, and to allow Italian delegates to enter the interior on Government business (*Journ. Central Asian Soc.*, Vol. 8, 1921, Part IV, pp. 177-178).

The development of these events affects to a marked degree the entire policy of Italy toward Mohammedans elsewhere. It is claimed that Italy's withdrawal from Valona in Albania after her prolonged efforts to maintain a naval base there in the negotiations of Paris, 1919–1920, was the chief basis of confidence on the part of the Senussi that Italy would treat fairly with them and with the rest of the Mohammedan world, for it was the Mohammedan population of Albania that particularly feared Italian encroachments upon

FIG. 1—Sketch map of Libya showing economic zones.

their territory. It will be remembered that by the secret Treaty of London, in 1915, Italy was to have a large section of Albania about Valona, and there was to be created out of the large block of central Albania an autonomous Moslem state under Italian protection. In framing this policy Italy, Great Britain, and France did not consult the Moslem population of Albania, and the announcement of the proposed action of these allies had aroused a certain resentment.

According to an elaborate report of a French mission to Tripoli, which, with Cyrenaica, as shown in Figure 1, forms the Libyan colony (Camille Fidel: Une mission en Tripolitaine, *Renseign. Colon.* (*Suppl. à l'Afrique Française*), 1921, No. 2, pp. 17-38; No. 3, pp. 47-58; No. 4, pp. 94-103). Italy has seized upon this occasion to ingratiate herself with the Mohammedans elsewhere, particularly in Anatolia. Her relations with the Nationalists of Turkey have been conducted in far better spirit than is the case of the French. It would be possible for Italy to take advantage of French and British difficulties with the Moslem and particularly the Arab world and make a common policy difficult. Germany's defeat has withdrawn her influence from the region, and this also opens the door for Italian aspirations.

In the report of Fidel alluded to above we have an admirable summary of the physical and economic conditions in Tripoli which confront Italian statesmen. There is an elaborate

table by provinces and types of population (No. 2, p. 20), and the totals are subdivided in the table so as to give also by territories the number of sedentary, semi-nomadic, and nomadic populations. The figures for the three classes named are, in round numbers, 356,000, 128,000, 84,000 respectively.

In passing from the coast toward the interior one finds four zones. The first is the narrow zone of the coast in which palm culture predominates but in which there are also cultivated olives, fruits, grains, and vegetables. The second zone is formed of high plateaus and is marked by deep valleys and steep-sided gorges which have only local sources of water. There are patches of forest, some development of the palm, and, outside the oases, stretches of territory suitable for cereal production and the growth of cultivated trees. These two zones have an extent of 50,000 to 60,000 square kilometers, or one tenth of the total surface of Tripoli; four-fifths of the population of the country; and almost the whole of the agricultural production and the production for export.

The third agricultural zone is constituted by scattered oases separated by great distances, such as Ghadames, Derj, Sinaun, Sella, and in valleys that descend from the mountains on the western border of the Gulf of Syrtes (Sidra). The author supplies figures for the extent of cultivation in the principal oases of this group.

The fourth agricultural zone includes the oases of Fezzan and Ghat, separated from the third by a broad stretch of practically useless desert except for minor oases.

In the cultivated lands the author emphasizes two quite different aspects. The first is characterized by irrigation, as in the oases, where the water table is at a slight distance beneath the surface. The other type is characterized by dryness, where agriculture is dependent entirely upon water that falls from the sky, and only exceptionally upon water supplied by torrents and available during the periods of rain. The oases of the coast are divided into small properties, and some are community lands under group control. The water is found at a depth of two to fifteen meters. European occupation has brought improvement in the method of pumping the water, electricity being substituted in some cases for animal motive power.

The oases of Tripoli produce sufficient for the needs of the inhabitants in good years; but on the whole rather primitive systems of cultivation are in vogue, and in bad years a certain amount of importation takes place. In the steppe lands barley is the chief cereal. It is sown in November and harvested in April, and the average production is 500,000 hectoliters per year. Alfalfa grows without irrigation in all zones of the steppe land of Tripoli, but particularly in the region of Gerian, where there is an immense extent of land devoted to it. It is sold in the markets of Tripoli, Homs, Misurata, places two or three days' journey from the interior by camel transport. A special commission visited Tripoli, in 1913, and its report has furnished a basis for the development of experimental agriculture and for the improvement of agricultural methods. In 1914 an agricultural station was founded, and a study was made of indigenous agricultural methods that can best be applied by Italian immigrants settled upon the land. Protection from the wind is one of the problems that confronts the government, in addition to the improvement of irrigation methods, the selection and adaptation of different types of culture, the technique of cultivation and harvesting, and the introduction of new species. Dry farming has been studied and also the fixation of dunes that threaten the settled places in the oases.

A problem of first importance in the improvement and pacification of the country is the building of new lines of railways and roads and the consolidation of existing ones. In such a land particularly, where settled places are far apart and difficult to reach, the railroad is the prime desideratum in the extension of military authority. It also promotes agricultural production, and this in turn affects the settlement and steadiness of the indigenous population. Of telegraph lines 1,400 kilometers have been constructed, and 1,250 kilometers of roads. The erection of public buildings and the improvement of ports, particularly the port of Tripoli, have been made matters of primary concern on the part of the Libyan government. A considerable quantity of capital distributed among a score of commercial houses or associations has been invested in works of improvement and development. These developments have also stimulated the trans-Saharan commerce that formerly was under the control of the Senussi. The author gives elaborate tables of the commerce of Tripoli, the exports and imports by years from 1912 to 1917 inclusive, and detailed items of export.

A large part of the paper is concerned with the political relationships, especially important because it is only through the control by treaty or by military occupation and pacification of the desert interior that Italy can retain her hold upon the trans-Saharan trade, which

would otherwise find its way to the coast of Africa about the Gulf of Guinea, or eastward to Egypt. Though Italian colonies are established only in the coastal belt, the government looks forward to their occupation of localities farther inland, for the coastal region is almost entirely occupied by small indigenous proprietors. Until the interior can be made secure, Italian immigrants will hardly be tempted to advance into it. Italy in fact is fighting a war against the desert and has in her hands a number of distinct agencies. Roads and railroads constitute one agency, her treaty with the Senussi chiefs is a second agency, and her improvement of agricultural conditions that will tempt Italian farmers is a third. The example of the Italian farmer is helpful to the native. It tends to fix him upon the land, to make him less and less nomadic, and if he can work out his destiny with the Italian farmer the government hopes thereby to establish a fraternity of interest between Italian and native which can only result in the more rapid reclamation of the desert. As was said at the beginning of this note, such a policy will permit the penetration of Italian capital in Moslem territory through the whole Near East, an event Italy looks forward to with great anxiety and hope because of her natural lack of raw materials on her home territory. Moreover, Italy is not unmindful of the advantages of a successful penetration of the Mohammedan world in her dealings with France and Great Britain inasmuch as these two powers are neighbors on either side of Libya. In addition, by the Tripartite Agreement of 1920 between Great Britain, France, and Italy, an agreement that displaces various prior treaties and agreements, these three powers are to enjoy equality of commercial privileges in their respective spheres of influence in Anatolia, and Italy has her special interests recognized in so-called zone C, which extends from the Smyrna region, through southern Anatolia, including Adalia, eastward to the Taurus Mountains. Italy's position in the Mediterranean is thus made distinctly stronger politically and economically. There is now in contemplation the introduction in Tripoli of a régime similar to that already established in Cyrenaica. This would give a large measure of local government and would enable the indigenous control of population to continue and to develop. The difficulty is that in Tripoli there is no head of a religious fraternity whose authority is generally recognized, and therefore in dealing with the local sects and groups a decentralized form of control must necessarily be adopted.

A Journey Across the Libyan Desert to Kufara. In the July, 1921, number of the *Geographical Review* reference was made to the remarkable journey to Kufara (Kufra) lately accomplished by Mrs. Rosita Forbes, details of which are now available in the August and September numbers of the *Geographical Journal*. The journey was commenced at Jedabiya, south of Benghazi, on December 8, 1920. The season of the year was unfavorable because of the strong cold winds—one of the reasons why Bedouin travel is done in summer rather than winter. Night temperatures on the outward journey ranged from 3° to 8° C.; noon temperatures rose to 44° C., and the occurrence of cold fog is noted. The real adventure of the expedition began when the oasis of Jalo was left and the expedition entered on the seven-day waterless stretch, traveling through flat, featureless country devoid of vegetation, an "amazing brown flatness, utterly unchanging—an endless, monotonous expanse of hard sand mixed with very fine gravel." For this section all the camel food and firewood had to be carried. The hummocks and dunes marking approach to the first of the Kufara group of oases were eagerly looked for and were first sighted in the morning mirage; "about an hour after dawn in the southern deserts a mirage regularly reveals for a few minutes the country lying anything from 30 to 90 kms. ahead, according to the height of the existing features. The Arabs call it 'the country turning upside down'." The route taken was east of that followed by Rohlfs, and instead of striking Taiserbo the expedition arrived at Buseima, typically situated by salt marsh and lake in a hollow between sand dunes and tabular mountains.

South of Jalo the population of Libya is Zouiyas with a sprinkling of the negroid Tebus, the original inhabitants of Kufara conquered by the Zouiyas a century and a half ago. These Arabs of the Senussi stronghold are a "fanatical warrior tribe, bitterly hostile to the advent of strangers, suspicious, cruel, and treacherous." Mrs. Forbes of course traveled in disguise (as an Egyptian Bedouin) and under letters from the present head of the Senussi confraternity, but the position of the party was extremely precarious. The population of Buseima, numbering some 100 (that of Taiserbo is estimated at 200 to 300) proved definitely hostile, as did that of other oases. In Kufara proper, however, the party was well received and permitted to explore two of the centers—Taj, the sacred city, on cliffs overlooking the wadi, and Jof, the chief mart on the floor of the wadi. It was said that no rain had fallen

in Kufara for eight years, but water is found almost everywhere in the wadi at a slight depth; and, thanks to a careful system of irrigation, vegetable gardens as well as palm groves flourish. There is practically no grazing, and camels are date-fed. When the rains of Cyrenaica are abundant the camels may be taken thither. On the other hand when the rains fail caravans come to Kufara seeking date fodder.

The return journey was made via Jaghabub, 80 miles west of Siwa, by a route of 15 days' actual traveling with only one water place, three and a half days from the starting point. Noon temperatures (late January and early February) averaged 33° C., and at night there were three or four degrees of frost. During a sand storm the noon temperature registered only 16° C.; the next midday it rose to 50° C. Leaving Kufara the expedition passed through a rough country, crossing three ranges of low tabular hills. Sandy wastes followed; "for three days we walked across unchanging flat sand covered with minute brown gravel." Jaghabub, which was reached February 10, lies near the Egyptian border and is a *zawia*, or Senussi college, not a political center or market.

Vegetationless Areas in the Libyan Desert. In all the so-called desert regions of the earth there are few areas that can be described as absolutely devoid of vegetation. In the Desert of Atacama Ball saw "a land absolutely without a trace of vegetable life," a comment endorsed by another eminent botanist, Philippi, who there traversed two stretches of 10 and 25 leagues length respectively absolutely without vegetation. In the Libyan Desert en route to Dahkla oasis MacDougal traveled a whole day without seeing a single plant. Another barren tract is reported by H. Hamshaw Thomas in a short discussion of ecological relations in the northeastern part of the same desert (Some Observations on Plants in the Libyan Desert, *Journ. of Ecology*, September, 1921). The observations were made some 25 miles northwest of Cairo. At this point, a mile and a half beyond the westernmost arm of the Nile, the alluvial flat terminates abruptly against a gravel plateau the surface of which is composed of small, wind-polished pebbles of quartz or sandstone. Occasional sand dunes or gravel ridges capped with sand occur, and in places are found the remains of silicified trees probably of late Tertiary age. During the rainy season (January to April inclusive) short-lived annuals appear, but "at a period when the annuals had disappeared I have traversed several miles on patrols without seeing a plant." Perennials are few and far between, occurring chiefly on the sandy patches. The extreme dryness of the air during much of the year, the intense heat of the sun on the quartz pebbles, and the unfavorable nature of the soil appear to be the chief limiting factors to plant growth. In possible amelioration of the last condition the author notes the discovery of an obscure lichen, a form of plant life which may prove to be of more abundant distribution here than has been suspected.

ASIA

Some Geographical Aspects of the Problem of China. The moment is opportune to call attention to an admirable and truly suggestive paper, "The Far Eastern Question in Its Geographical Setting," by Professor P. M. Roxby, of the University of Liverpool (*The Geogr. Teacher*, Vol. 10, 1919–20, pp. 82–90, 142–150, and 253–270). Professor Roxby's modestly stated aim "to chart some of the larger features of the field and to indicate a line of approach to the study of this great region" is to furnish material for an understanding of three great problems—the future of China (its future economic and political status), the competition of Eastern and Western countries in the world markets, the question of Oriental immigration into lands owned or controlled by "white" people.

Much of the difficulty of the Chinese problem is explained by the extraordinary combination of political weakness and social solidarity exhibited by the Chinese people. The basis of Chinese strength lies in the way in which the social and economic fabric has been adjusted to the land through long ages. "Farmers of forty centuries" have been tilling fertile alluvial plains under a monsoonal climate and hydrographic régime that necessitated much ingenuity of water control and irrigation device especially in the deltaic regions. To bring such a land under cultivation called for many arms and much organization, and centralized organization at that. The call for labor sanctioned the family cult. Professor Roxby indeed suggests an earlier basis in the patriarchal society of the western steppe lands whence, according to a commonly accepted theory, came the ancestors of the Chinese people. If this be so, they would bring with them to the valleys of northern China an instinct of family solidarity not less valuable for the new conditions of settled life. Thus "the value of a large family corporation received a new sanctity. It became endowed with the quasi-religious

attributes with which it is invested in Confucianism, a code emphasizing precisely those personal and social virtues which were already recognized as necessary to hold this particular type of society together." Hence the endorsement of a state which, appropriate enough at the time, can under modern conditions only be considered as one of overpopulation. Incidentally, however, population pressure seems to have bred a virile stock "accustomed to both long hours of labor and a low standard of comfort, inured to fatigue, and relatively immune from many diseases."

Other early civilizations were founded on a somewhat similar natural basis: Egypt and the several empires of Mesopotamia for instance; but, whereas in these regions of comparatively limited areas state control was absolute, in China with its vast area, its complicated topography, and its difficulty of communications Imperial authority was not incompatible with local autonomy, and that autonomy is primarily of the village, clan-family.

Through lack of the stimulus of contact with rival nationalities the isolation of China has proved another potent factor making against the development of nationalism. The physical barriers of mountain and desert have indeed been penetrated. Through Kansu and the Manchurian gates conquering invaders have come repeatedly, but they have always been assimilated to the mass of the people: China has been surrounded by peoples culturally greatly her inferiors. Conception of "the state as an object of patriotism and of the nation as the real unit of society" are nonexistent for the vast majority of Chinese. The lack of comprehension of the larger unit is seen in the oft-quoted anomaly between the honesty and efficiency of the Chinese in individual relations and the notorious corruption in public affairs and enterprises.

Shaping of the "amorphous" mass of China to a modern body politic involves the question of the preservation of her integrity. Considering the size and physical complexity of the country and the mixed racial origins of the people the unity of civilization and customs is unusual. Religious antagonism also is notably absent save in the steppe borderlands of Kansu and Shensi where a large Mohammedan population has created somewhat of a "northwest frontier" problem. The disrupting forces now in evidence appear to be founded largely on topographic isolation with associated difference of outlook. There are, however, other differences of culture and economy that have been concisely portrayed by Berthold Laufer in his often-quoted paper "Some Fundamental Ideas of Chinese Culture" (*Journ. of Race Devel.*, Vol. 5, 1914–1915). Particularly in the southeast with its complex topography is communication difficult. Canton has its maritime interests and is more open to ideas from overseas. Peking, on the contrary, is in close touch with the grasslands and tends to be dominated by military or quasi-military chiefs. Geographically it would seem that the balance between north and south might be held by the Yangtze provinces, stabilized by the great agricultural, industrial, and commercial interests of that middle region, with the obvious center of Nanking.

The sketch of social conditions in China is brought into higher relief by contrast with Japan. An outstanding fact in the political geography of Japan is the existence until recent times of an internal military frontier. Colonization of the islands by peoples migrating from the Asiatic mainland was accomplished slowly. At the beginning of the Christian era the frontier was south of the Kwanto plain in which are situated Tokyo and Yokohama. The colonization of Hokkaido (the recent change of name from Yezo, barbarian, is noteworthy) can only be said to have begun. Such a condition favored development of the military virtues and retention of a feudal system under military leaders. The force of the ancient patriotism was seen in the successful wars with China and Russia wherein the latest military strategy was associated with the prevailing spirit of *bushido*. The opening up of Japan found her with a leader class ready to embrace a new system of national policy and with the means for carrying it into execution.

Recognition of these deeply-rooted ancient social forces and their basis must be implicit in any study of the problems of the Far East. Professor Roxby has done a service in setting them forth so clearly as a preliminary to consideration of other geographical aspects of the present political situation upon which also significant suggestions are made.

Flood Control As an Aid to Relief from Famine in China. Dr. Charles K. Edmunds, President of Canton Christian College, contributes articles to the *Trans-Pacific* (June, July, August, October, 1921) and to *Asia* (June, 1921) in which he discusses the question of famine in China as caused by drought and flood. The present famine was due to drought, the culmination of three bad years. It may be compared to the catastrophes

of 1878 and 1832 when the same sections of Honan, Shansi, Shensi, Shantung, and Chihli were devastated. In analyzing the records of famine over a period of 1,000 years Dr. Edmunds finds that 800 widespread droughts occurred, 91 being of special severity. While such droughts cannot be eliminated, much might be done to mitigate their severity. There is need of afforestation and more scientific agriculture, of improved methods of transportation and irrigation, and greater knowledge of meteorological and hydrographic conditions, especially as connected with water control and thus with the prevention of famine by flood.

While the lower reaches of all the important rivers of China are subject to heavy flood, it is the Yellow River that is particularly affected. A recent survey of the problem here has been made by the American engineer John R. Freeman acting for the Grand Canal Improvement Board. The volume of the Hwang Ho is comparatively small as it enters the sea—the discharge at high flood is only half that of the Yangtze at low water—but the amount of silt carried is great, and with subsidence of the summer floods there is considerable deposition. During flood time, however, the river tends to re-excavate its bed in these temporary deposits. For instance, observations during the flood in 1919 showed that along 100 miles of its course the river had dug a bed 10 feet deep. It is estimated, in fact, that 99 per cent of the total load of sediment is carried out to sea. This suggests the solution proposed by Mr. Freeman. He would straighten the course of the river, confining it in a narrow channel by new dikes and thus compelling it to scour its own bed. Water for irrigation would be drawn off by pipes through the dikes at suitable points; and much land now waste, including that between the old and proposed dikes, might be reclaimed.

The Hwang Ho, by usurping in past times the courses of the Wei to the north and the Hwai to the south and raising their beds, has diverted their courses. The former now flows to the sea through the Hai Ho at Tientsin, the latter reaches the Yangtze via a system of lakes draining to the Grand Canal. The Hwai in particular offers hydrographic problems. The lower basin is exceedingly flat, and the river is furthermore prevented from finding a new course eastward to the sea by the Great Maritime Dike built 1027 A. D. and the dikes of the Grand Canal. Streams draining from the Shantung hills to this portion of the North China plain are also held back and during flood contribute to the excess of water carried to the Yangtze. The proposal for control is similar to that for the Hwang Ho. It involves the construction of a straight channel confined by strong dikes whereby the flood waters from the entire area can be united and carried off direct to sea. At the same time some of the lake areas could be drained and given over to agriculture, others could be improved as storage reservoirs for irrigation purposes. Afforestation in Shantung and the creation of reservoirs in the borders of the hills would further aid regulation of flood waters. Included in the drainage problems of the plain between Hwang Ho and the Yangtze Kiang is rehabilitation of this section of the Grand Canal and thereby a material help to communication.

A Recent Study of Life Zones in Southeastern Asia. The belt of very deep valleys and high mountains compressed within narrow limits between the two great elbows of the Yangtze Kiang on the east and the Brahmaputra on the west was long a region of uncertain physical geography. The explorations that have revealed its character are matters of recent times and are still far from being complete. Their chief result has been to lay down upon the maps the principal orographic lines and the courses of the three closely spaced and parallel streams that drain the area—the Irrawaddy, the Salween, and the Mekong.

Among the important contributory explorations are those of the naturalist F. Kingdon Ward, the results of which have appeared in a number of books and articles, the latest being the volume "In Farthest Burma" (1921). A hydrographic study recently discussed in the *Geographical Review* (Vol. 7, 1919, pp. 413–415) is now followed by "The Mekong-Salween Divide as a Geographical Barrier," (*Geogr. Journ.*, Vol. 58, 1921, pp. 49–56) which describes the region in further detail, and we now have the relief features for the first time brought into something like an accurate relation to the distribution of life. One of Captain Ward's main contentions is that we have here a quite distinct contrast to the life conditions that obtain in the Himalaya Mountains. In the matter of control over major distributions the Himalayan ranges form part of the boundary between the Oriental and Palearctic regions. East of the elbow of the Brahmaputra the line of separation between northern and southern faunas is the Yangtze-Yellow River divide, or watershed, except for the ten degrees of longitude between 95° and 105°, where no clearly defined boundary exists owing to the north-south trend of the mountains and valleys within the aforementioned narrow belt. If the Mekong-Salween divide, and the parallel chains, break the

continuity of the major line between northern and southern life forms and confuse distributions and boundaries, they also, because of their southward trend over nearly fifteen degrees of latitude, form a dividing line between two subdivisions of the southern, or Oriental, belt that extends from the Arabian Sea to the Pacific. Of this fifteen degrees five hundred miles are highly effective boundary, though the northern and southern ends are less so. "The faunas of the Indian and Chinese subregions of the Oriental region are in fact surprisingly different." The boundary between the two is the Mekong-Salween divide, and it is this feature rather than the north-south migration and commingling of Oriental and Palearctic forms that is the chief distinction of the narrow mountain belt under consideration. The author lists a half dozen animals characteristic of the typical Indo-Burmese fauna that are not found east of the Salween.

In the northwestern part of the narrow belt under consideration, namely in the unexplored Salween-Brahmaputra divide region, there appears to be a transference of the function of a faunal and floral barrier from the Salween range to the Salween-Brahmaputra divide. This transference of function takes place at the 28th parallel, but toward the northwest its details have still to be worked out by further exploration. Hardly less marked is the effect of the Mekong-Salween divide in cutting off an eastern Asiatic floral region. Many genera and species are confined to the western side of the barrier; and many others are poorly represented east of the barrier, both in species and numbers. Likewise a number of plants east of the Mekong do not cross the divide to the west. Only at the southern end of the barrier, where the mountains are lower, is there intermingling in a broader zone.

The author would recognize in southeastern Asia a new subregion among Asiatic life zones, to be called Sino-Himalaya. "This would comprise the Himalayan and perhaps Trans-Himalayan ranges as far north as the Salween; the Burma-Yunnan ranges as far east as the Mekong down to the twenty-first parallel of latitude; and mountainous western China as far east as the province of Hupeh northwards to the Yellow River. This mountain region has a common flora and fauna and is characterized by many endemic genera. It cannot conveniently be treated as part of the eastern Asiatic region on account of its strong Indo-Malayan connection; similarly its Palearctic connection is vitiated by its Oriental relationship. On the other hand it is characterized by numerous endemic mammals. . . ."

AUSTRALASIA AND OCEANIA

The Origin of the Salt Deposits of South Australia. The origin of the salt deposits of South Australia is discussed by R. Lockhart Jack in a report on the salt and gypsum resources of the state (*Geol. Survey of South Australia, Bull. No. 8*, Adelaide, 1921). Salt is widely distributed throughout South Australia, as is the occurrence of saline ground water. At present the chief deposits worked are in Yorke's and Eyre's Peninsulas and Kangaroo Island. The lake basins, or playas, contain water from a few inches to several feet deep during the season of winter rains, and with the disappearance of the water in summer there is reaped the salt harvest from a crust ½ inch to 3 inches thick. The workability of deposits farther inland is dependent on improvement of transportation facilities. Since construction of the Transcontinental Railway exploitation of Lake Hart and other interior basins has begun.

Three theories are advanced in explanation of the deposits. The first derives the salt from beds of rock salt leached by the accession of ground water during the rainy season, the second from "fossil" salt held in the interstices of the marine beds during deposition. Neither of these theories is supported by the geological facts as known today. The southern portion of Yorke's Peninsula may be taken in illustration. Overlying basal rocks of Pre-Cambrian age is a relatively impervious argillaceous Permo-Carboniferous till, overlain in turn by patches of Tertiary limestone, clays and sands, the last of eolian origin. The capping layers are thin, averaging less than 20 feet, relatively porous and capable of absorbing the whole normal rainfall. Wind action, erosion, and solution have excavated numerous pans, or lakes, whose bottoms are formed by the impervious till thus affording excellent opportunity for the accumulation of salt. In none of the beds is rock salt known to occur. Salinity of the waters held in the beds may be explained by impregnation from above. In fact, in rocks of every type and geological age in South Australia, wells and mines have yielded both fresh and saline waters. "Fossil" salt could hardly be held in the till: from the thin porous Tertiary beds it would apparently have been leached out long ago or, if held in such condition as to be released only on erosion of the containing rock, would be available

only at a very slow rate. It appears, however, that there is no definite proof of decrease of output; though the amount fluctuates according to seasonal conditions. The salt is said to be of "cyclic" origin, derived from the evaporation of sea spray in the air, blown over the land and washed down to the surface by rains. Thence it may be removed by the run-off, may be left in the soil by evaporation, or may be carried down to the ground water making the latter more or less saline and, where topographic and geologic conditions are right, contributing to the formation of salt lakes. Climatic conditions are highly favorable to genesis of the salt deposits. The rainfall is small and run-off is correspondingly feeble. Rains are seasonal, falling during the winter in the form of numerous light showers. The average for Yorke's Peninsula is 17.5 inches distributed over 100 days. Evaporation is high. The 50-inch line of net annual evaporation crosses the head of Spencer Gulf.

The association of gypsum with the salt is so marked as to suggest community of origin. It seems probable that a large proportion has been carried over from sea water with the cyclic salt. With the gradual concentration of the water in the salt lakes the gypsum crystallizes out and subsequently, where not protected by a layer of the hygroscopic salt, is blown by the desiccating northerly winds to form belts of gypsiferous earth or even dunes at the southeastern ends of the lakes.

Dust Whirls in Western Australia. In the Proceedings of the Royal Society of Victoria (Vol. 32, 1920, pp. 314–322) J. T. Jutson, who has written on various phases of erosion under arid or subarid conditions in Western Australia, briefly describes the dust whirl as a factor operating therein. Dust whirls, as Mr. Jutson points out, have been described by W. M. Davis (Elementary Meteorology) and E. E. Free (*U. S. Dept. of Agric. Bur. of Soils Bull. 68*, 1911), the latter giving a useful list of references; but there are few recorded descriptions of their occurrence in Australia. The present paper notes the occurrence of 43 dust whirls in Western Australia, where they are locally known as "willy-willies," and describes one in full. The whirls were observed in the northern part of the Coolgardie gold field in a subarid region (rainfall averaging 10 inches or less). The whirls were of varying height—from a few feet to some thousands—and varying diameter. They appeared as columns rotating in clockwise or anticlockwise direction, the latter predominating, and moving in linear directions. They were commonest in the summer and on days of calm or of only light airs. Even the smallest whirls were violent in action, and it is evident from their numerous occurrence that they must accomplish a great deal in the way of erosion and transportation. Dust is carried high and far and undoubtedly is "exported" from the place of origin to add to the thickness and mixed character of the soils outside the region. Sand settles locally, tending to drift in the hollows and contributing to the shaping of the vast high level plain of the south-central section of Western Australia.

PHYSICAL GEOGRAPHY

Peat Deposits As Evidence of Climatic Change. The realization that climate is by far the most variable geographical factor is leading to a constantly increasing study of climatic changes. One of the interesting phases of this study is the way in which new lines of evidence are being sought out. To the ordinary eye all the layers of a peat bog seem much alike unless marked by sand, clay, or stumps. The specialist, however, finds that equally important phases are indicated by numerous less obvious conditions. For example, where the ordinary fibrous matter of peat is mixed with large amounts of decomposed or macerated material a condition of high water and abundant rain is indicated. Where the material is almost purely fibrous, no matter whether it forms fine threads or is coarse and woody, relatively dry conditions are usually inferred. Again, the chemical structure of the peat, that is the extent to which it is colloidal, or impregnated with lime, shows the degree of concentration of salts in the water and thus furnishes a key to the climate. In addition to this, microscopic examination of the traces of leaves, pollen, seeds, and other plant materials, washed or blown from surrounding trees, reveals unmistakable evidence of the climate in the regions surrounding the bog.

On the basis of such criteria Mr. A. P. Dachnowski has been making a study of the peat formations of the eastern United States, especially Ohio (Peat Deposits and Their Evidence of Climatic Changes, *Botanical Gazette*, Vol. 72, 1921, pp. 57–89). By correlating the peat bogs and the moraines along a line running northward from Canton to Cleveland, Ohio, he finds evidence of an irregular series of climatic changes since the last glaciation. While the author's conclusions are as yet purely tentative, they are of considerable interest for

comparison with conclusions based on other evidence. As nearly as they can be defined the main stages since the height of the last glaciation are as follows:

1. The cold period of the main advance of the Wisconsin Ice Sheet.

2. "A time during which a cool and dry climate bordered closely the glacial regions." This period was apparently double, there being a break in the middle. "It was probably a period of winds, cool from the ice sheet, and of loess deposition." On the glacial till left exposed by the retreating ice, marsh plants and low shrubs appear to have been the only dominant plants.

3. A second great advance of the ice, the Later Wisconsin, probably not so severe as the first.

4. "A prolonged warm and humid climate—this appears to have been the period of invasion and wide dispersal of forest trees from the south and of a more northerly distribution of certain species than is now recorded for them." This period, it should be noted, resembles the warm, humid period which Brooks, as explained elsewhere in this number of the *Review*, places at 4000 B. C. Dachnowski, however, gives no clue to its date. It may be earlier than 4000 B. C.

5. "A return to cooler and drier climate."

6. "A temperate and more humid period than exists at the present time in the same localities."

7. "The present period is probably approaching a climate of rising temperatures and (or) decreasing precipitation. The botanical data, however, are as yet insufficient to permit more definite conclusions, and they are wholly inadequate for drawing a parallel between the past climatic conditions of different countries."

Although Dachnowski's studies are only preliminary, they agree with those of a constantly growing body of investigators in showing not only how numerous the climatic pulsations have been since the glacial period, but how far toward our own day they continue.

ELLSWORTH HUNTINGTON

GEOGRAPHICAL NEWS

The Centenary of the Geographical Society of Paris. In July last the Geographical Society of Paris celebrated the centenary of its foundation. The several functions included a meeting presided over by the President of the Republic and attended by representatives of official institutions and learned societies, among them a number of foreign geographical societies. Mr. W. L. G. Joerg represented the American Geographical Society. The opening of the meeting by M. Millerand was followed by addresses by Prince Roland Bonaparte, President of the Society, the Vice-President, M. Henri Cordier, Sir Francis Younghusband, President of the Royal Geographical Society, and other distinguished guests by whom tribute was paid to the work of the Society. The Geographical Society of Paris has been closely associated with the colonial and economic expansion of France that, following the Restoration and the general peace of the second decade of the last century, has been maintained ever since. French geographers and explorers have played an important part in the opening up of Africa and the creation of a great French Empire therein, and this is reflected in the wealth of African material contained in the publications of the Society. The Society has consistently given support to African exploration from the time when the award of 10,000 francs, offered to the first French traveler to set foot in Timbuktu, was made to Caillé in 1828. Recent expeditions organized by the Society include the Foureau-Lamy mission across the Sahara to the Congo (1898), the Lenfant mission to the Niger-Benue-Chad region (1903), the mission for the study of sleeping sickness (1906), the mission to the Ivory Coast for geodetic and forestal studies (1908), and the scientific mission to Morocco. The Ollone mission to western China (1906), was instituted by the Society, which has also had part in other important Asiatic explorations.

At home the Society has been responsible for the creation of provincial geographical societies (after the decentralization movement of 1870) and the Society of Commercial Geography of Paris (1876). Besides numerous special publications the Society has published its bulletin continuously from 1822, since 1900 under the title of *La Géographie*. The centenary is commemorated in a special number, July-August, 1921.

The Explorers Journal, A New Publication. The first number of the *Explorers Journal*, a publication of the Explorers Club appeared in November of last year. The *Journal* which will be issued monthly is primarily designed to keep members, especially non-resident members fully informed of the affairs of the Club.

The first number details the plans for purchase of a new club house at 47 West 76th Street and announces a series of symposia on the technique of exploration to be held during the winter. Notes on current exploration will be an important feature of the *Journal*.

OBITUARY

William Speirs Bruce, the distinguished Polar explorer and naturalist, died in Edinburgh on October 29, 1921, at the age of 54 years. Dr. Bruce began his career of Polar exploration as naturalist to the Scottish Antarctic expedition of 1892-1893. He acted as zoölogist to the Jackson-Harmsworth expedition to the Arctic, 1896-1897, and as naturalist to Major Andrew Coats's expedition to Novaya Zemlya and the Barents Sea in 1898. He was leader of the *Scotia* (Scottish National Antarctic) expedition of 1902-1904 and editor of the reports of the scientific results, several volumes of which have appeared. As an explorer Dr. Bruce's name is also particularly associated with the Spitsbergen archipelago to which he made a number of journeys, the first as naturalist to the Prince of Monaco's expedition of 1898-1899, the last in 1920. As founder and director of the Edinburgh Oceanographical Laboratory Dr. Bruce has carried on in worthy fashion Edinburgh's traditional interest in modern oceanography. In 1920 he was awarded the David Livingstone Centenary Medal of the American Geographical Society, an account of the presentation of which appeared in the July, 1921, number of the *Geographical Review*.

Manuel Vicente Ballivián, the eminent Bolivian publicist and geographer, died in La Paz on August 7, 1920, at the age of 73. The greater part of his life had been spent in service of the state, first in the Bolivian Legation at Paris, then acting successively as commissioner of the territories of northeastern Bolivia—where he carried out a series of arduous explorations—, as head of the Department of Immigration and Statistics, and as minister of Colonization and Agriculture, in all of which capacities he constantly labored to promote the geographical and economic knowledge of his country. It was in recognition of his notable accomplishments in this field that he was awarded the David Livingstone Centenary Medal of the American Geographical Society in 1917. Señor Ballivián was president of the Geographical Society of La Paz and author and editor of numerous works on Bolivian history and geography.

GEOGRAPHICAL REVIEWS

The Racial Problem in World-Politics

Lothrop Stoddard. **The Rising Tide of Color Against White World-Supremacy.** With an Introduction by Madison Grant. xxxii and 320 pp.; maps, index. Charles Scribner's Sons, New York, 1920. $3.00. 8½ x 5½ inches.

Few phenomena are more interesting than the waves which mark the progress of civilization. During recent centuries one of the greatest waves has been that of self-government which perhaps reached its height in the World War. Another was the wave of universal education which is still supposed by many to be the panacea. A third is the wave of mechanical invention, transportation, and the physical mastery of nature. These three waves have put the world in a state of biological and social chaos whose importance is only gradually being realized. In the attempt to bring order from this chaos there have arisen two other waves which bid fair to be dominant factors in the next century. One is the insistent call for sound health as the basis for meeting the conditions arising from emigration, manufacturing, city life, and all the other new environmental features. This wave is discussed in Professor Binder's "Health and Social Progress," reviewed elsewhere in this issue. The second wave is that of eugenics. It has reached the stage where the work of the pioneers like Galton is succeeded by books like Grant's "The Passing of the Great Race," and Humphreys' "Mankind."

To these popular attempts to arouse the world to a sense of impending danger Lothrop Stoddard has recently added another. The gist of Mr. Stoddard's book is that modern transportation has brought the various races of the world into much closer contact than ever before. Hence old political and racial rivalries are intensified, and new ones arise. Only when transportation has had time to do its complete work will the world settle down into a state of relative stability. What race will then dominate the world no man can say, but the white race will no longer be dominant unless it looks well to its laurels.

That the world is passing through a great crisis and that the composition of races is one of the most vital factors in determining future events can scarcely be doubted. Whether the crisis really takes so alarming a form as is supposed by Mr. Stoddard remains to be seen. After an introduction in which Mr. Grant restates some of the conclusions of "The Passing of the Great Race," Mr. Stoddard divides his book into three parts: (1) The Rising Tide of Color; (2) The Ebbing Tide of White; (3) The Deluge on the Dikes. In the first he discusses the colored races. He shows how the yellow man, the brown man, and even the black man and the red man have been gradually aroused to a certain degree of self-consciousness by contact with the white man and especially by sharing in the World War and by the knowledge thus gained of the white man's weaknesses and losses. Numerous quotations show that the Hindus, the Chinese, and especially the Japanese are restive under the white man's arrogant assumption that the world belongs to him. The quotations are highly interesting, and Mr. Stoddard is to be congratulated on his ability in finding and using them. Nevertheless, he perhaps takes the newspaper fulminations of a few agitators more seriously than they deserve to be taken. If he had lived or traveled extensively among the colored races he might feel more strongly the difference between the small group of agitators who go so far as to talk of a "Pan-Colored" alliance against the white man, and the enormous body of the common people who show little if any sign of being roused from their age-long apathy. Only in Japan is there any serious departure from this condition, but Japan was the most progressive of the so-called "colored" countries long before it came into contact with the white man, and its spirit is more like that of Europe and America than that of Asia.

In the second part of his book Mr. Stoddard summarizes the achievements of the white race, its marvelous expansion in numbers from perhaps 70,000,000 in 1500 A.D. to 550,000,000 in 1900 and the remarkable expansion of its power over almost the entire earth. Against this he places the losses of the World War and the evidences that the white man's disregard of eugenic precepts is gradually weakening his power.

Finally in "The Deluge on the Dikes" the author speaks of the outer dikes as the regions where white men exercise political control but there is no settled white population. He points out the strength of the agitation against white control in Asia and says in conclusion: "That this profound Asiatic renaissance will eventually result in the substantial elimination of white political control from Anatolia to the Philippines is as natural as it is inevitable." This conclusion he bases on the idea "that men worthy of independence will sooner or later get independence." Therefore, since the yellow men and the brown men by their past achievements have shown themselves worthy of independence, the best thing the white man can do is to move out of Asia with as good grace and with as little conflict as possible. But he must not let the brown Arabs overrun Africa and the yellow Chinese overrun Latin America. That would bring the colored peril close to the inner dikes—the places where the white man actually lives.

The "colored" peril has three parts: the peril of arms, the peril of markets, and the peril of migration. Mr. Stoddard recognizes that the peril of arms is slight except under certain almost impossible contingencies. The peril of markets seems to him more important, for he holds that the yellow people have the capacity for manufacturing as well as the white people. This may be true in Japan though it is doubtful in the rest of Asia. The question is not only whether the yellow men have the innate capacity, but whether the climate and other environmental features under which they live permit the constant energy and mental alertness which seem to be indispensable for the higher types of manufacturing. As to the peril of migration the case seems clearer. Mr. Stoddard may not be right in saying that all the white man's "marvelous achievements are due solely to heredity," for the fact that aside from Japan the white man occupies all the regions where the physical environment is highly favorable may have a great deal to do with the matter. Nevertheless, the greatest danger which today confronts the white race in general and the United States in particular is probably the dilution of a fine, capable racial inheritance with stocks of less capacity, both white and colored. In the clear and forceful manner that is characteristic of his entire book the author points out that "the East can *underlive* the West" and thereby drive out the westerners wherever the two attempt to compete on equal terms. This is true not only of Asiatics but of eastern and southern Europeans. Whenever such people mingle with those of higher heredity, they do not lift the superior type to a higher social level, as is often supposed, but actually drive it out, or rather prevent it from being born, as is rapidly happening in New England. This is not because the lower type is biologically the "best" but because it is willing to increase and multiply regardless of its own standard of living and that of its children. The higher types, on the contrary, refuse to lower their standards by rapid multiplication and therefore die out. The forceful way in which this great truth is brought out makes Mr. Stoddard's book deserve not only careful reading but careful thought in order that its conclusions may be acted upon.

ELLSWORTH HUNTINGTON

MODERN ITALIAN EMIGRATION

R. F. FOERSTER. **The Italian Emigration of Our Times.** xv and 556 pp.; indexes. (Harvard Economic Studies, Vol. 20.) Harvard University Press, Cambridge, 1919. $2.50. 9 x 6 inches.

Studies of present day migrations are being added one by one to the materials of the student of the humanities. The volume in hand represents a marked advance over its predecessors and contemporaries in at least three particulars. Instead of considering the immigration of a given national group into one country only, it adopts the standpoint of the migrating people, whose separate currents of movement over the world are chronicled as distributaries of one great stream; instead of being written by an apologist for or a historian of this or that nationality, it is the work of a student of social affairs whose breadth of approach gives it the stamp of catholicity; instead of being written from personal information combined with reference to a limited range of written sources, it is the product of prolonged and extensive study of voluminous and widely scattered documentary material, corroborated by some field work.

The reader will not lay the book aside without regrets: he will wish that evidence collected from diverse and unequally authoritative sources might have been more nearly harmonized, or at least that he had been given a thread to follow through the maze of confusing and contradictory facts; he will feel that more intensive field work in Italy would have repaid the

necessary effort; and he may take issue with the tendency to put a better face on the movement than the evidence of the documents warrants.

The work leaves little to be desired in certain respects: as a repository of much exceedingly useful information, no small part of which has been beyond the reach of most students in the United States; as an example of organization which might be followed profitably in dealing with other great migrations of this age; and as formulating certain general conclusions with respect to such migrations, which, if tentative as yet, may prove to be fundamental when the evidence from other emigrations is available.

The outline of the material is simple, and its key is furnished by an admirable topical table of contents. Following some forty pages of summarized conclusions, which seem heavy with statistical facts until reread in the light of the more extended subsequent treatment, is an inquiry into the causes of migration, within typical sections of Italy and within every foreign country whither Italians have gone in significant numbers. The marked contrasts between emigration from northern Italy and emigration from southern Italy, the broad similarities of the separate movements into European countries, the significance of the settlement in North Africa, and the striking differences between South American and North American immigration, are set forth in the midst of a rich store of detailed information as to the extent and character of the migrations. The final hundred pages of text deal with the motives of the individual migrant and with the private and public consequences of his activities.

Although the book is primarily a study in the field of social economics and therefore stresses the business of wresting a living from foreign and not always hospitable communities, neither the geographic basis nor the moral and political consequences of this business have been neglected.

The geographer will find the richest offerings in chapters three, four, and seven, which deal chiefly with the conditions of the natural environment in Italy. The ultimate potent cause of emigration is seen to be the lasting inferior economic position which Italy holds in comparison with her neighbors in western Europe, or with the American countries. This inferior economic level affects the people mainly through backward and handicapped agriculture (the principal occupation of the country); and the conditions which hamper agriculture are (1) water erosion and avalanches in the uplands, (2) deposition of gravel on, inundation of, and malaria in the lowlands, and (3) aridity everywhere. Undeniably all these untoward conditions are worse today than formerly. To account for the deterioration the hypothesis of climatic change is suggested but is expressly left aside as unneccessary to the argument, which is rested upon known deforestation which took place during the eighteenth and nineteenth centuries. As a result of this deforestation the seasonal torrential rainfall has produced the discouraging conditions enumerated above, which in turn have enforced extensive agriculture, have resulted in niggardly crops, have compelled the peasants to live in the uplands and to traverse long distances to their work on the fertile but malarial lowlands, and, by depopulating these lowlands, have made possible open field brigandage. Rarely have the economic and social consequences of a geographic condition been traced in such detail.

From southern Italy, where the evil consequences of deforestation are most apparent because of the unsatisfactory distribution of rainfall, emigration first took place from the populous uplands, where agricultural land was scarce, and among those who received a medium wage and who were therefore able to get away and yet were not tempted to remain. From northern Italy, nearness to more favored countries which could offer better pay than the homeland seems to have been the magnet of attraction. The emigrants from both sections have served mostly as unskilled laborers, either on the soil in Argentina, Brazil, and North Africa, or as construction hands and the like in the United States and in continental Europe. In France, Germany, and Luxemburg they perform the most laborious tasks in the steel mills and mines. Those who are skilled workmen are mostly miners, quarrymen, and stonecutters, adhering to trades which they learned in producing their native extensive mineral wealth. Fruit vending is popular among those who assay business for themselves, particuiarly if they be Sicilians. In the Plata, along the African littoral of the Mediterranean, and off the Dalmatian coast, the fishing is chiefly in the hands of Italians—Chioggian in the Adriatic, Ligurian elsewhere.

The later chapters contain numerous additional references which throw light on the economic geography of this or that country of immigration, but the materials for political geography are more considerable. Pages 212–222 on North Africa illuminate the well-

known quarrel between Italy and France over Tunis with facts which most historians have failed to note; the discussion of the work of Italians in effecting an economic and political renaissance in Argentina is a vital study in the comparative influence of environment and tradition (which is itself, in one view, a product of past environment); Chapters 22 and 23, dealing with the effect of emigration on general Italian foreign policy, show that Italian national imperialism is bulwarked by, if not sprung from emigration.

The chapters on the United States are almost purely economic in scope. Italian emigration thither is recent, and most of it is seasonal and transient. Consequently there has been little opportunity for reactions by or upon the environment. Perhaps because of this situation Italians in the United States disclose sharply a trait common to their compatriots elsewhere—they carry to their new homes the regional antipathies and separatist tendencies which are the product of age-old geographic separatism within Italy.

Each of the chapters on the countries of immigration contains valuable statistics of the geographic and occupational distribution of immigrants within the country and of their origin within Italy. Figures on emigration appear in the first two chapters of the volume and in the Appendix. All these may be found readily with the aid of the general index, which is unusually well prepared. The special student will find materials well in hand in the two-column bibliographical index of nine pages. Nearly every page of the text is elaborated with footnotes containing quotations from the sources.

Combining careful workmanship, broad scholarship, and readability, the work proves that romance need not be excluded from a work of erudition, provided the subject is a vital one.

D. S. WHITTLESEY

RECENT BOOKS OF TRAVEL IN ASIA

EDMUND CANDLER. **On the Edge of the World.** 278 pp.; map, ills., index. Cassell & Co., Ltd., London, New York, Toronto, and Melbourne, 1919. 8 x 5¼ inches.

ELLA AND PERCY SYKES. **Through Deserts and Oases of Central Asia.** xii and 340 pp.; maps, ills., index. Macmillan & Co., Ltd., London, 1920. 21s. 8½ x 5½ inches.

A. DE C. SOWERBY. **Sport and Science on the Sino-Mongolian Frontier.** xvi and 295 pp.; ills. Andrew Melrose, Ltd., London, 1918. 8½ x 5½ inches.

S. POLLARD. **In Unknown China: A Record of the Observations, Adventures and Experiences of a Pioneer Missionary During a Prolonged Sojourn Amongst the Wild and Unknown Nosu Tribe of Western China.** 324 pp.; maps, ills., index. J. B. Lippincott Co., Philadelphia; Seeley, Service & Co., Ltd., London, 1921. 25s. 9 x 6 inches.

R. C. AND Y. B. ANDREWS. **Camps and Trails in China. A Narrative of Exploration, Adventure, and Sport in Little-Known China.** xxv and 334 pp.; maps, ills., index. D. Appleton & Co., New York and London, 1920. $5.00. 8½ x 6 inches.

These books of travel, all well illustrated, have in common the fact that they deal with frontier regions on the marches of the old Chinese Empire. In each instance the peoples dealt with arouse particular interest in the traveler from their contrast with neighboring folk, and in each region Nature is impressive—wild mountain country or desert wilderness. If it is the "sun-baked, barren ridges, the shifting, windswept sand-dunes, and the saline, brackish swamps of the Ordos Desert" that cast the strongest spell on Mr. Sowerby, Mr. Candler in "On the Edge of the World" succumbs to the glories of the mountains "back of Kashmir." The latter author has produced a delightful volume. He touches traditional phases of Indian life and landscape but in such a charming and whimsical manner that the most ordinary subject is given new life. To his writing he brings much of the insight and philosophy of a Kipling and a scientific knowledge and interest. Mountains and pilgrims and pilgrimages are his main themes. The sacred places of the high mountains, the cave of Amarnath, the lake of Gangabal call forth sympathetic description; with its degenerate priests, the shrine of Jawala Mukhi, the Sacred Flame, in the foothills back of Amritsar evokes an unattractive contrast. Of special interest is the visit to Nanga Parbat "a wild country and a wilder people"—mountain raiders who terrorize the Kashmir peasantry. Particular mention may be made of the excursion to the Rakiote glacier, previously visited by Mummery, Bruce, and Collie with whose reports its present aspect is compared. There are also a couple of journeys in Persia—on the old Baghdad-Kermanshah road and in the Bakhtiari foothills.

In "Through Deserts and Oases of Central Asia" the authors have extended their Persian field of travel to the Pamir and Chinese Turkestan. Chinese Turkestan is a curious mixture of Russian, Chinese, Hindu, and Moslem customs and religions, for it is not only a frontier region but through it runs the great ancient road from China to the Occident. The population of this vast plain, 1000 miles from east to west and half that distance from north to south, is estimated at 1,500,000, mostly confined to the oases that form only 1½ per cent of the entire area. Its two types, settled and nomadic (with a small semi-nomadic division), are administered separately by the Chinese government. Details of the history and geography of the land are given by Sir Percy Sykes in the second half of the book: the first half written by Miss Sykes is narrative.

Mr. Sowerby, joint-author with Robert S. Clark of "Through Shên-Kan" (Shensi-Kansu), has continued his explorations on the Sino-Mongolian frontier—that is the frontier as defined by the Great Wall, which to a great extent follows the natural boundary rather than the present political boundary. The work done was in the nature of scientific and geographical research, including the collection of biological specimens, the making of geological notes, the carrying out of compass traverses (unfortunately the exigencies of wartime publication prevented inclusion in the volume of the promised map), and general investigation into the lives, customs, and conditions of the natives. Regarding the last field the author, who was born in China and knows the people and their language, makes observations specially interesting at the present time. The Mongols he describes as a wretched remnant of a noble people degraded by a degenerate religion until they bear no resemblance to the tribes that under Jenghis Khan swept Asia and eastern Europe in a conquest that has never been equaled. Along the border the Chinese are steadily advancing, pushing further and further into Mongol territory. The several explorations are described in separate chapters, and there are also chapters on the biological work and on the flora and geology of the region.

The "Unknown China" of Mr. Pollard is the country he styles the home of the Yangtze Kiang, Nosuland, a semi-independent district of Szechwan bordering on Yünnan. The connection with the Government is chiefly the sending of tributes, one of which consists of the yearly despatch of forty-eight horses to Peking—at least the Nosus start them on the journey leaving it to the petty officials en route to decide whether they shall ever reach their destination. Among the aboriginals of China the Nosuland tribes are unique in that they possess a written language, ideographic like the Chinese but bearing no other resemblance to it. A completely organized feudal system is in vogue.

Mr. and Mrs. Andrews have written an account of the Asiatic Zoölogical Expedition of the American Museum of Natural History to China in 1916–1917. The destination of the expedition was the remote border province of Yünnan. The route was by way of Shanghai and Foo-chow with a brief stop-over in Fukien—an unsuccessful attempt to secure a specimen of the so-called "blue tiger." Ethnographically Yünnan is interesting as the seat of some thirty semi-independent non-Chinese tribes, some of whom represent the original inhabitants of China. It maintains a rather indifferent attitude towards the affairs of the government, with which it has little connection except through the media of tax collectors and other petty officials. The people are simple, kindly, hospitable, with a wealth of interesting folklore. The collection of 3,300 specimens and a large number of photographs and picture films is reported. The scientific results will be published by the Museum. From the present volume, which has the character of a popular narrative, details of scientific interest have been largely eliminated.

The Economic Geography of Siberia

Richard Pohle. **Sibirien als Wirtschaftsraum. Eine Einführung in das Leben Sibiriens.** viii and 66 pp.; map, bibliogr. Kurt Schroeder, Bonn and Leipzig, 1921. 9 x 6 inches.

Richard Pohle has to his credit a number of regional studies that are as thoughtful as they are brief and unpretentious. The essay under consideration is fortified at every turn by statistics and references to vital sources. At this time the Siberian realm is of special interest because the character of its development will depend largely upon the outcome, ultimate as well as immediate, of the Washington conference on the limitation of armaments and Far Eastern questions. Pohle regards Siberia as a house with two fronts: an eastern, which is still free for possession by the strong, and a western, which is irretrievably held by Moscow. The effect is to deny to West Siberia an outlet to the world-encircling and commercially life-

giving sea, an outlet that alone could give that region a distinctive culture and a modern industrial and social organization. It is still a *colony* of Europe and will long remain in that relation. It is the strength manifested by these restraining forces in the past that gives a sure clue to future development. Fighting against a close and distinctive organization of Siberian life are the great distances between Siberian centers of trade and life and between Siberia and the main life currents of the world. Too much space must be overcome. Too much space, economically useless at the present time, separates the areas of profitable production. The separatist tendencies of East Siberia are seen in the formation there of a republic two years ago. Midway between the eastern and western division of Siberia is a nodal area—the Lake Baikal region. An old trading mart, far removed from the seats of power, the life of Irkutsk and the region round about is freer from political considerations than that of the eastern or western marches. The Trans-Siberian railroad completed in 1905 has connected these dissimilar geographical elements, and it is indeed a very slender band of union.

Under these conditions the eastern border bids fair to become the scene of infiltration and possibly of possession by the yellow race, while the western border will long be traversed by eastward-moving cultural and political agencies. In the four-year period from 1907 to 1910, inclusive, Japanese fishing ships in Russian waters increased from 109 to 301, their tonnage from 11,675 to 49,307, and the number of fishermen from 1,174 to 7,332. In the same period the Russian fishing stations on the Okhotsk-Kamchatka coasts increased from 4 to 22 and the Japanese from 70 to 127. And four-fifths of the Russian catch goes to Japan. Japanese political control of Korea and southern Manchuria and the spirit of all her military and economic advances are in harmony with these figures.

Both the agricultural production and the agricultural potentialities of West Siberia are so great, and the capacity of the railroads is so small, that a short and cheap route to the sea and the world's markets has been a constant prepossession. But the Kara Sea, a great ice reservoir, is only navigable for two months, at the most, each year. In the period 1874–1905, 118 ships sought to make the passage via Kara Sea to Ob-Irtish outlets on the Arctic coast, and of these but 86 reached their destination. The Ob estuary is forbidding, for ice lingers in it so late that the river is free from ice but 146 days of the year at Obdorsk. The bar at the mouth has but three-fourths of a meter of water. Projects have been planned to construct railroads from the Ob to Barents Sea in order to avoid these difficulties.

The cotton and dried fruits of Turkestan are in contrast to the agricultural products of the temperate region farther north, and there thus exists in West Siberia a basis of exchange; but it is not nearly enough to make the region self-sufficient, so that West Siberia for both export and import must depend upon European Russia.

Set between the East and West is Middle Siberia, with a population scarcely greater than one-third that of West Siberia, whose products, namely, those of the Far East, particularly from China, find their way across West Siberia but do not stop there in any great quantity. Long continuous stretches of territory may be developed in West Siberia; in Middle and East Siberia there is a greater extent of upland and mountain, with deep and crooked valleys and greater remoteness and isolation in consequence, so that nuclei of settlement are scattered about in a non-continuous pattern.

Pohle has included in his paper a wealth of statistical material, recent and accurate, which furnishes the fundamental basis of his analysis of the life and relationships of the different parts of Siberia. He deals with the population increase of the different regions in late periods; and, though these periods are not always closely comparable owing to the unequal dates for which statistics are available, they yet furnish a reasonable basis for comparative growth and prosperity.

The northern border of the Siberian realm comes in for a certain amount of detailed treatment of high geographical interest. Whereas on the west of the Urals, between the Arctic coast and the Black Earth district, there are fourteen degrees of latitude, the belt between Cape Chelyuskin and the Black Earth district is twenty-four degrees wide. There appears to be a rather close correspondence between the trend of the coast and the southern border of the tundra. The map opposite page 1 shows this unmistakably until we reach the Stanovoy Mountains, where Arctic influences in the lee of the continent push the southern border of the tundra southward to the base of the Kamchatka Peninsula. The broad belt of the *taiga* reinforces the difficulties of distance from the sea and both *taiga* and tundra have only scattered settlements of natives or island-like settlements of gold diggers.

The author has something to say of the reindeer problem. He finds all parts of the tundra

accessible, and extensions of land supporting reindeer are found in the mountains south of the tundra belt in the midst of the *taiga*, where the forest cover is broken by uplifts that bear appropriate vegetation. Supplementing the reindeer is the chase, and wide spaces foster such activities. Goods such as bread, flour, tea, sugar, etc., which neither the forest nor the tundra can yield, are imported. Hunting and fishing are supplementary sources of food.

There are abundant statistics of production and area in the three chief sections of Siberia, and these complete the picture of the relations of man to his environment in this remote and widely extended land where the conditions of life are so uniform over broad stretches and where the frontier is not a narrow belt but a broad one half a continent wide.

Principles of Regional Geography Applied to Russian Turkestan

Arved Schultz. **Die natürlichen Landschaften von Russisch-Turkestan.** ix and 66 pp.; maps. (Abhandlungen aus dem Gebiet der Auslandskunde, Vol. 2.) L. Friederichsen & Co., Hamburg, 1920. 11 x 8 inches.

It is the introduction to this paper that is of chief significance. In it the author briefly reviews the principal articles dealing with the question of natural regions from Herbertson (1905) to Gradmann (1916). He then analyzes the relation between general and special regional studies and gives thirteen categories of structural facts necessary in a study of the natural regions of a country: orography, climate, genetic morphology, hydrography, dynamic morphology, agriculture, plant geography, animal geography, genetic anthropography, ethnography, demography, economics, and transportation. It is, of course, not assumed that these subjects will be developed with that fullness of detail that the specialist in these various fields would demand, nor that all of them are necessarily applicable to a given region; but rather that they should be developed where applicable in their geographical aspects. Had he stopped here the author would have laid himself open to grave criticism as being the newest addition to the long line of special pleaders who believe that they can trace geographical influences through the affairs of men without taking into account the multitude of ways in which man's course is directed independently of geographical circumstances and conditions. Such dependence upon the formula of geographical control or influence would not be objectionable if the result were labeled "suggestions." When the result is put forward as proof the effect is disastrous. For man does not react to nature alone; he reacts to life itself—to the past of his kind, to emotion, to desire, to ambition.

Each problem of man arises from a complex of forces, of which some may be geographical. These must be studied in their relationships or they have no meaning. Well does Schultz say that the ultimate object of geography is the ecology of man and his culture; and that it is a mistake to limit the study of natural regions to their physical geography without consideration of cultural regions in their anthropogeographical relationships.

The distinction made between the nucleal and marginal portions of a natural region is particularly suggestive. Often the marginal belt may be broad and marked by transitions from neighboring regions. It is the nucleus that has the distinctive features of the region. Its characterization is especially significant. Important also are the differences of environmental detail here and there, which may indeed have exceptional influence in the distribution of man and may significantly modify his life within the general framework of a region. Without attention to environmental details the whole regional treatment may prove weak or break down altogether.

After the author has laid down his principles of regional study he applies them to Russian Turkestan. The result has many praiseworthy features, especially from the pedagogical standpoint. Geographical data are conveniently and closely organized. The relation between the author's theory of regional treatment and his practice is, however, not always clear. In the chapter entitled "Bodenkundliche Gliederung von Turkestan" there does not appear to be any established connection between the physical characters of the soil and the distribution of people. Other chapters on the physical data are to less degree disconnected with the main theme, yet all suffer from a certain detached quality as if they were separate essays on as many different subjects. Doubtless they broaden the reader's background and hence have a certain value. The paper must be judged principally by Chapter 14, entitled "Die Landschaften Turkestans." Here we have the various regions grouped according to their physical character. But one looks in vain for penetrating reasons for the classification adopted. The chapter may be characterized as containing a series of dicta put into technical

terms. For example on page 62 there is a discussion of the nucleal area of a region and the character of the border zone, but the whole matter is expressed in physical terms. The author runs through his list of categories, that is to say his outline, and tells us why he puts things together. But in hardly a single one of the 10 principal subdivisions or the 30 minor subdivisions have we a view of the life of the region in its physical setting. The lack of collation of geographical data is a serious disappointment after the excellent introduction. Nor is the reader greatly helped by a series of 15 maps which illustrate the paper and which give the plant and animal geography, the physical features, etc. They present appropriate and interesting data, but their relationships are left to the reader. In short, the whole paper is less a regional treatment than an essay on the material for a regional geography of Russian Turkestan. Three of the maps, those dealing with the ethnography, the distribution of population, and the agricultural divisions, are taken from the Atlas of Siberian Russia, published in 1914 by the colonization bureau of the Russian Government.

On Formosan Forests

Ryozō Kanehira. **Anatomical Characters and Identification of Formosan Woods with Critical Remarks from the Climatic Point of View.** 2 and 317 pp.; diagr., ills., bibliogr., index. Bureau of Productive Industries, Taihoku, Formosa, 1921. 10 x 7½ inches.

This excellent work is divided into four chapters. Chapter 1 deals with the vegetational character of the ligneous flora of Formosa. Chapter 2 includes the histology of the secondary wood of 386 species together with short notes on external and chemical character such as color, density, flavone content, etc. Chapter 3 is an artificial key for the identification of Formosan woods. Chapter 4 contains a summary and critical remarks from a climatic standpoint. As a basis for the latter, study was made of 160 species of Philippine woods and 181 species from Japan proper.

The island of Formosa lies between latitude 25° 30′ and 21° 40′ N. and longitude 119° and 122° 10′ E. The area is 13,890 square miles, of which about 80 per cent (7,024,000 acres) is forested. Wild peoples inhabit about two-thirds of the forest area.

Topographically the island may be divided into two parts, the mountain district and the plains district, the former being occupied by the central range of mountains which for the most part belong to the Paleozoic formation. This range extends north and south, and many of the highest peaks are more than 12,000 feet above sea level. The existence of these mountains in a tropical and subtropical region is conducive to a very rich forest flora.

The number of known indigenous plants comprises 169 families, 1,185 genera, 3,608 species, and 78 varieties. A study of the geographical distribution of the woody plants of the island shows for 998 elements the following results: Endemic, 36 per cent; China, 18 per cent; Japan, 14 per cent; India, 13 per cent; Malaya, 10 per cent; Philippines, 5 per cent; Australia, 3 per cent; Africa, 1 per cent. There is much evidence that the island was connected with the mainland of Asia until a comparatively recent period.

Three forest types are recognized: (1) Evergreen broadleaf forest, about 2,274,000 acres; (2) mixed broadleaf trees and conifers, about 424,000 acres; (3) pure coniferous forest, approximately 585,000 acres. The coniferous forests are first in economic importance because of the more serviceable timbers they produce. The trees of highest economic value belong to three families, namely, Coniferae, Cupuliferae, and Laurineae. Only a small part of the very rich and extensive forest area is subjected to any form of utilization, partly because of the savage inhabitants but more especially because the whole region is very difficult of access on account of the steepness of the mountains.

From the climatic point of view the Formosan flora may be divided into four zones, namely, tropic, warm, temperate, and frigid. The tropic zone is confined to areas below 1,000 feet altitude and has two distinct types of vegetation, that of the plains region and that of the tidal forests. The latter comprises two subtypes, the mangrove and the beach forest. *Ficus* is the representative tree of the plains district as mangroves are of the coast swamps. Most of the trees of the beach forest are of Indo-Malayan origin, owing their distribution probably to the sea currents. The vegetation of the plains region is highly variable since the land is mostly in cultivation.

The warm zone is mostly occupied by evergreen broadleaf trees, with very few scattered conifers, and comprises a large proportion of the forest. The principal families are Laurineae, Cupuliferae, Urticaceae, Euphorbiaceae, Leguminosae, and Ternstroemiaceae.

The principal trees of the temperate zone are the conifers *Chamaecyparis obtusa* and *C. formosensis*, with certain broadleaf trees often in mixture. Higher up *Pinus Armandi* appears in the sunny places, and large specimens of *Tsuga formosana* are found on the cliffs.

The vegetation of the frigid zone is very simple, with pure stands of *Abies Kawakamii* predominating. Higher up the mountains are grassy slopes with some low shrubs.

The author discusses the local occurrence of trees and shows that, despite the smallness of the island, there are many plants which have only a very local distribution. He also compares the ligneous flora of Formosa with that of Japan and the Philippine Islands. Gymnosperms are represented in Formosa by 14 genera, in Japan by 17, and in the Philippines by only 7. Pine trees are very common in Japan but occur only scatteringly in Formosa. In Japan the most valuable and widely distributed coniferous trees are "hinoki" (*Chamaecyparis obtusa*) and "sugi" (*Cryptomeria japonica*), while in Formosa "hinoki" and "benihi" (*Chamaecyparis formosensis*) are the predominant conifers. "Without 'hinoki,' in Formosa, the utilization of the forest would have been at a very great disadvantage."

As to the dicotyledonous trees, the Philippine flora has a strong representation of the higher orders, the Japanese of the lower; while the Formosan is intermediate. Dipterocarps, the predominant trees of tropical Asia and the most important commercially in the Philippines, have no representatives in Formosa. In striking contrast to the largely deciduous forests of Japan there is very little tropical deciduous high forest in Formosa. "This is due to the climate which has no prolonged dry season; and it is a rather interesting point that in the southern parts of Koshun, where the dry season comes in winter, there are [some] deciduous trees."

SAMUEL J. RECORD

THE RAINFALL MAP OF SOUTHERN AFRICA

J. R. SUTTON. **A Contribution to the Study of the Rainfall Map of South Africa.** Maps, bibliogr. *Trans. Royal Soc. of South Africa*, Vol. 9, 1921, Part 4, pp. 367–414. Cape Town.

The rainfall of South Africa has been studied and charted by several authorities, among them J. G. Gamble, Karl Dove, Raulin, Tripp, Buchan, and others. Buchan's maps are reproduced in Bartholomew's "Atlas of Meteorology," 1899. Recently J. R. Sutton, of Kimberley, who has contributed several valuable studies on various meteorological phenomena of South Africa, especially of Kimberley, has also given attention to the rainfall. Mr. Sutton's first paper, entitled "An Introduction to the Study of South African Rainfall" (published in *Trans. Phil. Soc. of South Africa*, May, 1904) dealt with 160 stations having records of long periods.

In his present contribution Mr. Sutton has used the monthly and annual rainfall values for 567 stations in South and East Africa. Hence he is able to give us a much more complete and accurate cartographic presentation, as well as descriptive and explanatory account, than has heretofore been possible. Most of the computation of the averages was done by the author himself. The aim has been to use all existing records of ten years or more. A good many cover over twenty years, and two (Rietfontein and Kimberley) cover 40 years. Records of less than 10 years have been used for areas not well supplied with gauges, "since it has seemed better to get an approximation to the average rainfall at such places than to ignore them altogether." In only one case has any interpolation been attempted. There is no statement of any reduction of the records to a uniform period. The stations are grouped in 30 sections, 17 of these being essentially those used by the late Meteorological Commission of Cape Colony. Descriptive and explanatory notes are given of each section. The area included extends as far north as to cover southern Angola on the west of the continent and the whole of Portuguese East Africa on the east.

There are thirteen maps (9 by 12 inches) showing the isohyetal lines for the twelve months and for the year, drawn on a base on which the main features of the relief are indicated. One feature of special interest stands out, and that is the few conspicuous instances in which there seems to be any marked influence of the mountains upon rainfall. Topographic effects are seen along the terraces facing the Atlantic, in a few other cases, and, most strikingly, in the Zoutpansbergen of northern Transvaal. The latter are the only obstacle to the unbroken course of the tropical dry belt across the continent. The explanation given by Mr. Sutton is that most South African rainfall comes in thunderstorms,

"whose origins and tracks are largely independent of the geographical contours, and whose clouds are higher than most of the mountains." These conditions are obviously unlike those in regions where mountains are great breeding places for thunderstorms. The monthly maps show that the control of the rainfall is less dependent upon the topography than upon the seasonal migrations of the main rainfall belt to and from the equator. The winter rains of the southwest advance as the summer rains retreat, and vice versa. Similarly also the southern and southeastern coastal belt rains advance and retreat seasonally. Occasionally the winter rains of the southwest, and the southern coastal belt rains also, advance inland as far as Kimberley and Bloemfontein.

There are special brief discussions of the mean hourly variation of rainfall at Kenilworth (Kimberley); of the average number of rainy days; the greatest rainfall in one year; and the heaviest rainfall in 24 hours, for each section. A note on South African hailstorms brings out some interesting facts. Several cases of remarkably large hailstones are recorded. At Maritzburg in April, 1874, hailstones were "too big to go into a breakfast cup" (4½ by 3½ inches in diameter; weight 1½ pounds). In another hailstorm in December, 1915, one stone measured 4 by 4 by 4½ inches. Numerous hailstones fell which weighed over three-quarters of a pound. Many sheep were killed. One hailstone went through a roof of corrugated iron, leaving a hole about 3 inches in diameter. Two observers reported that the majority of the hailstones were the size of tennis balls.

A bibliography is appended which will prove useful in any general or historical study of the subject.

R. De C. Ward

Rural Life in New York State

E. O. Fippin. **Rural New York.** xv and 381 pp.; maps, diagrs., ills., index. (Rural State and Province Series, edit. by L. H. Bailey.) The Macmillan Co., New York, 1921. 7 x 5 inches.

Agriculture, the oldest of industries, is, in the minds of many of those who practice it and of more who depend upon it for the necessities of life, a little-understood vocation just to be taken for granted, like gravity. Both producers and consumers need enlightenment as to the factors on which agriculture depends.

The farmer needs an understanding, not merely of the practices and methods of his community, but of the whole agricultural region in which he lives. He needs further to appreciate the significance to him of industrial developments in other fields and how these change market demands. He must have an agricultural perspective on the country and perhaps the world; he must know when conservatism in agricultural practices is sane and when foolish. He must know agriculture as it is, however untenable this new knowledge may make the agricultural faith he may have inherited from the past.

The consumer, whether in home or factory, needs to appreciate that modern farming is a business and, like other lines of business, is subject to economic laws and principles. As a matter of useful information and for his own guidance he should know the reason of the distribution of agricultural areas, the reason for general farming in the northeastern states, why land apparently going to waste may mean agricultural efficiency, why farmers cannot change crops as readily as a machine shop can change patterns, what must be produced near to the consuming area, why the marketing of farm products is often costly, and many other matters that the up-to-date farmer has to understand and appraise in planning and carrying on his business.

Fippin's "Rural New York," the first of a series of volumes on the several states of the country, is a book for urban and rural people. The reader—and he can hardly fail to be an interested reader—will find that this little volume gives a real understanding of rural New York and throws much light upon rural life and conditions in the other northeastern states where mixed, or general, farming predominates.

The volume is well ordered, clearly written, and, barring many illustrative maps that are too minute for usefulness, eminently successful. It should be widely read, for it is a distinct contribution to our literature on rural life. No one can fail to gain from it a better appreciation of farming as it is and a keener sympathy for the farmer, who must often labor with only a partial understanding of the conditions that influence his success. No would-be back-to-the-lander, particularly in New York state, should fail to study this volume carefully before he "obeys that impulse."

Richard Elwood Dodge

A Guide to the Mohave Desert

David G. Thompson. **Routes to Desert Watering Places in the Mohave Desert Region, California.** vii, 4, and 87–269 pp.; maps, ills., index. *U. S. Geol. Survey Water-Supply Paper 490-B.* Washington, D. C., 1921.

A widely-read periodical recently stated in an editoral note that "The Great American Desert" is no longer on the map and that tourists in automobiles now safely cross districts where pioneers years ago lost their lives struggling in the sands. Both statements are in a measure true; but the great desert is still there, and travelers sometimes find a trip across it dangerous in spite of the comparative ease of automobile travel. Competent testimony on both these points is found in an important paper, lately issued by the U. S. Geological Survey. The preface by O. E. Meinzer, a widely experienced observer, states:—"The desert region of the United States forms a great triangle whose base, 800 miles long, is the Mexican border from the Peninsular Mountains, in southern California, to the mouth of Pecos River, in Texas, and whose apex is in north-central Oregon. . . . It covers about 500 000 square miles or very nearly one-sixth of the area of the United States. This region is by no means devoid of natural resources or human activity. It contains prosperous cities, fertile agricultural districts, forest-clad mountains, a large aggregate number of watering places, many rich mines, and an unknown wealth of mineral deposits. But the localities that have water supplies are widely separated oases in a vast expanse of silent, changeless, unproductive desert whose most impressive feature is its great distances and whose chief evidences of human occupation are the long, long roads that lead from one watering place to another. In the future existing oases will be enlarged, many new ones will be created, and the mineral and agricultural product of the region will be greatly increased. But in spite of all that man can do this large region will remain essentially a desert."

As to the disappearance of the name "Great American Desert" from our maps, that is natural enough; such a name is unpopular because it is unattractive to settlers; no western territory or state would relish being represented in a region so called. Even the word "oasis," although truthfully and courageously used by Meinzer as quoted above, is commonly replaced by "settlement," which carries with it no suggestion of a barren desert around it. But in the interest of candor and accuracy, the plain facts deserve frank statement. The most important among them are, on the one hand, the vast extent of the desert region and, on the other the great value of its oases and mineral deposits. The text of the above-named paper by David G. Thompson, although chiefly devoted to accounts of roads and watering places in the Mohave desert district to which it is limited, contains also general and useful information by which popular misapprehensions may be corrected. The Mohave district, including Death Valley, was selected for description because its 60,000 square miles in southeastern California and southwestern Arizona include "the driest, hottest, and least explored part of the desert region." Its three type forms, isolated mountains, piedmont alluvial slopes, and basin-center *playas*, are briefly characterized; many mountain ranges and more than fifty *playas*, large and small, are shown on the accompanying maps. The erroneous idea that a desert is completely devoid of plant and animal life is corrected; an observant traveler may see a considerable variety of both. Mineral products have been large; from 1894 to 1918 San Bernardino county, or that part of the Mohave desert which occupies southeastern California, yielded $56,000,000, largely in gold and silver; but these products are inconstant; they rise and fall rapidly; and the mining towns, being dependant entirely on more fertile districts for their supplies, are as a rule short-lived: thus Calico, which is said to have had a population of 5,000 in the late eighties, has had only three or four inhabitants in recent years. It is otherwise with the irrigable areas; for, although they are not of great extent in this driest and hottest part of the vast desert region, they are likely to prove permanent assets to the nation.

Valuable information is given under "Suggestions for Desert Travel." It is remarked that "until recent years the traveler in the desert used burros or horses and wagons as his means of transportation. Since the advent of the automobile the use of horses has nearly ceased. With this change travel in the desert has become less difficult and has therefore increased very much. . . It must not be supposed, however, that travel in the desert with an automobile means travel without danger. In some respects the danger has increased. It is much easier to get a long distance from known watering places with an automobile than with a team, and a breakdown at a remote point may be very serious. Since automobiles

have come into use there is also much more travel by persons not familiar with the region through which they are going. Moreover, with automobiles numerous difficulties may arise that were not encountered by those traveling with horses and wagons. . . . No one should go in an automobile far from a town who is not sufficiently familiar with the mechanism of the machine to make necessary adjustment of the carburetor and spark plugs and other minor repairs or who cannot make repairs to tires. This seemingly needless statement is made because there are many persons who know only how to manipulate the throttle and brakes of their cars. The writer has come upon such persons stalled on main roads of the desert, and they would have been in a bad plight on less traveled roads."

Inasmuch as "such persons" appear to exist in large numbers, and as the desert actually exists in large area, there seems to be about as much danger when they attempt to cross it as there was in the early years of pioneer travel.

W. M. Davis

Health as a Factor in Human History

R. M. Binder. **Health and Social Progress.** xi and 295 pp.; index. Prentice-Hall, Inc., New York, 1920. 7¼ x 5 inches.

One of the hopeful signs of the future is the growing recognition that man is biologically an animal. Books like Professor Binder's "Health and Social Progress" are helping the world to see this because they emphasize the intimate relations among three great factors, first the biological inheritance with which a man is endowed; second the physical health and energy with which he uses his endowments; and third, the external conditions such as education, religion, and government which determine the direction of his energies and the degree of wisdom with which they are used. Professor Binder stresses health, which is today perhaps the most neglected of these three factors. The thesis of his interesting book is that "No people has ever succeeded in rising above the level of savages unless it possessed at least fair health; where either economic or climatic conditions prevented health, no civilization could arise; and where it had arisen it was doomed whenever new conditions arose which undermined health." His description of the perfect poise and vigor of the man whose health is so good that he absolutely forgets his body is fine. So, too, is his discussion of many indirect ways in which even a slight departure from perfect health leads to discontent, poor work, poor temper, bad judgment, and general inefficiency.

Even more interesting is the author's summary of what has actually been accomplished by measures for the eradication of hookworm disease, pellagra, and other ailments. It is an extraordinarily significant fact that "about 940,000,000 out of the 1,600,000,000 people on the globe live in countries where hookworm disease is prevalent," and that in many of these countries the percentage of infection ranges anywhere from twenty to ninety per cent. When this is put with such facts as the following it shows that we are here face to face with one of the greatest of all the means of progress during the next century. "In Costa Rica sixty-six laborers before being treated for hookworm disease normally cultivated 563 acres of coffee monthly. After being treated for hookworm disease they cultivated 750 acres, resulting in a net monthly increase in wages of 27 per cent, after allowing for a 15 per cent reduction in unit pay. Moreover, in India, Clayton Lane reports that the amount of work increased 20 per cent on one estate and 50 per cent on another, and on both was of better quality than before the laborers were treated; while reports from British Guiana indicate that the efficiency of the laborers employed by one company increased from 25 to 50 per cent after hookworm measures were put into operation." Moreover, as Binder shows repeatedly, the deadening effect of poor health on man's capacity and happiness is a prime factor not only in backward regions, but even in our own country among people of high intelligence.

It is to be regretted that a book which contains so much that is good is marred by minor inaccuracies and overstatements and by an unusually strong tendency toward broad generalization with little or no visible basis of fact. For example, Sweden is stated to have the lowest death rate and longest life of all countries, although the *Annuaire International de Statistique* gives the death rates per thousand inhabitants for 1908–1913 as follows: Denmark 13.2, Norway 13.6, Netherlands 13.9, and Sweden 14.0; while England and Wales stands at 14.1, and New Zealand and Australia stand much below 14.0. Again olive oil and silk are given a prominent place among the "tropical" imports into the United States. Worse than these minor errors is the fact that in his enthusiasm for his subject the author minimizes the importance of everything else. For instance, he attributes ill health almost uni-

versally to parasites and food and makes an elaborate attempt to show that inheritance and climate are of minor importance. With this goes an unfortunate tendency to start with a thesis and "prove" it instead of starting with the facts and seeing what they prove.

Worst of all the author makes categorical statements which neither he nor any one else has proved: "The foods produced in the north could produce in combination with other favorable factors prevailing there, a strong physique and a strong brain, but not a fine nervous system and brain. The digestive organs were too much overburdened, for instance, with the assimilation of starch in northern latitudes, and the nerve fiber could not become as fine as that which was nourished on sugar." All this and much more is stated without a single qualification, as if it were a well demonstrated geographical truth, whereas it is merely an interesting hypothesis which is worth investigation. Nevertheless, Professor Binder's book well deserves reading. It stresses a great truth which geographers, economists, and historians must some day recognize, namely that the health of a people is at least as important as the material wealth of their country.

ELLSWORTH HUNTINGTON

A TEXTBOOK OF PRINCIPLES OF HUMAN GEOGRAPHY

ELLSWORTH HUNTINGTON AND S. W. CUSHING. **Principles of Human Geography.** xiv and 430 pp.; maps, diagrs., ills., index. John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London, 1920. $3.50. 9 x 6 inches.

This is a textbook designed "to set forth the great principles of geography in its human aspects," to make clear "the relation of the physiographic environment to man's activities." In general, the arrangement of material and the allotment of space are commendable. Two-thirds of the book is devoted chiefly to the direct responses of man to the great elements of the physical environment—to location, land forms, water bodies, soil and minerals, and climate. The last third deals for the most part with man and his work in the leading climatic realms but includes brief chapters on the world's diet, man's changing surroundings, and the elements of political geography. The book is noteworthy for its many crisp, picturesque passages, some of which are written in a truly fascinating manner. Such discussions as that of the Kirghiz nomads (pp. 12–21) will help to arouse in students a lively interest in human geography. Many of the questions and problems at the ends of the chapters are adapted to promote clear and original thinking on the part of the student.

In spite of its good qualities the book, in the judgment of the reviewer, fails in its purpose and, except perhaps when used with caution by well-trained teachers, cannot give the "solid grounding" in human relationships which it was intended to provide.

1. The treatment is not consistently adapted to students of a given degree of maturity but varies from that appropriate in the elementary school to that suitable for the later years of the university. Pedagogically this is a serious defect. Such attempts to aid the young reader as that made on page 168 in indicating parenthetically the correct pronunciation of the word "prospecting" will prove amusing to more mature students.

2. In avoiding a technical treatment of the physical environment the authors have gone so far in some cases that the student doubtless will not get a clear understanding of the *effect of the environment on life*. The authors' viewpoint is reflected in the statement that "for practical purposes it makes relatively little difference how a plain or mountain originates" (p. 81). But it is important, for example, that the student shall understand the *characteristics* of delta plains, flood plains, lake plains, glacial plains, etc. (largely ignored in this book), if there is to be more than a superficial understanding of life responses in such areas. Certainly it would be unfortunate if the student shared the opinion of the authors that "under similar conditions of location, soil, and climate, plains of all kinds are much alike in being level places where the soil is deep" (p. 81); for most plains are not level, and in some of them the soil is not deep. Similarly the student would understand better the *effects* of climate if more were said concerning the *characteristics* of climates of different types.

3. A textbook should distinguish sharply between fact and theory; failure to do so tends to develop the cocksure, half-baked opinions frequently held by college sophomores. This is not done in the case of the tetrahedral theory (p. 51 *et seq.*) and of Dr. Huntington's theories concerning climatic changes and their human relations (pp. 370–374).

4. Although most of the illustrations are well chosen, some are not well placed or are not made to supplement the text effectively. Thus a map showing the migration of the cotton boll weevil appears on page 306 but is not referred to until pages 360 and 375 are

reached. Some of the maps, unfortunately, are open to much more serious criticism. For example, Figure 53 (p. 178) is intended to show the distribution of the more important deposits of iron ore but omits those of Brazil, Newfoundland, and Cuba. Figure 61 (p. 191) is designed to show the distribution of coal production but indicates no production for China and India, both of which furnished more in the last year of normal production (1913) than Canada, the output of which is shown. No dates are indicated for any of the production maps—an unfortunate omission since production varies from year to year. The map showing the "principal railways of South America" (Fig. 29B, p. 71) fails to indicate some 700 miles of the longitudinal railway of Chile, which is one of the greater railway facts of the continent.

5. The great need of promoting the more efficient utilization of natural resources is recognized, but many of the statements which relate to their conservation seem to reflect only a slight acquaintance with the problems involved. The statement concerning the value of crop rotation (pp. 159–160), by implication complete, ignores its value in reducing the ravages of insects, in helping to overcome plant sickness (soil sickness), and in helping to prevent reduced yields through the influence of toxic bodies. The "danger" that the German reserves of potash "would prove insufficient" is assigned (p. 164) as a chief consideration which led the United States government to undertake a search for new sources of supply. Since the deposits near Stassfurt contain 2,000,000,000 tons of potash, enough to supply the world for some 2,000 years at the present rate of consumption, this "danger" manifestly was not imminent; and Congress, unaccustomed to look 2,000 years ahead, of course was moved by other considerations. In noting the sources of phosphates (pp. 163-164), no mention is made of the phosphate rock deposits of Utah, Idaho, Wyoming, and Montana—the largest known deposits in the world. Similarly in considering (pp. 199-200) what we shall do in the future for petroleum products or substitutes for them, no mention is made of the oil-shale deposits of Colorado, Wyoming, and Utah—the most important deposits of the kind known. In listing the varied uses of petroleum (pp. 196-197) the use of kerosene as an illuminant is not noted, although by another writer it has been aptly termed "one of the greatest of all modern agents of civilization." On page 203 the astonishing statement is made that when a satisfactory solar engine is available "we may hope at last to get rid of our coal mines." Surely Dr. Huntington has heard of the scores of products important in the arts, the industries, and medicine, that are derived from coal! The "great difficulty of the Mississippi waterway" is discussed on pages 138–139. Its channel depth of 9 feet to St. Louis apparently is considered adequate; but its lower course is winding, it is subject to seasonal floods, and especially it does not flow toward the eastern manufacturing districts and Europe. Then follows the categorical declaration that "if the Mississippi flowed from St. Louis to Baltimore or Philadelphia it would pay to spend a billion dollars instead of the hundred million already spent in improving [its] navigation." Reflection upon the fact that the Erie Barge Canal, with a channel depth of 12 feet and connecting the Great Lakes with the drowned Hudson, carries almost no freight might well cause one to hesitate about making such an unqualified declaration. The restricted use of the water power of this country (p. 149) certainly is not due to the impracticability until recently of transmitting the power any considerable distance from its source in the form of electric energy, but chiefly to unreasonable restrictions and hazards imposed by the Government prior to the passage of the Federal Water Power Act of 1920 and to the competition of power derived from coal and oil. In other words, the stagnation of water-power development continued for years after it was practicable to transmit the power long distances.

6. Various statements made in Chapter 19, on the world's diet, do not conform to the facts which have been definitely established by medical science. For example we are told (p. 350) that "a good diet must contain two main elements—carbohydrates and proteids" and that "in addition to these two main food substances certain others called vitamines, and the acids of fruits, are needed in smaller quantities." It is a well-known fact that to sustain life a diet must contain proteids, salts, and water, and that to promote growth and carry on body functions, either fats or carbohydrates are essential. That is one of these latter can replace the other for a time. A "good" diet should contain proteids, carbohydrates, fats, salts, water, and the accessory food factors—vitamines. "The Eskimo wants much fat because he needs carbohydrates to keep him warm in his far northern climate" (p. 354). But fats contain no carbohydrates. "Many equatorial people have protruding abdomens because of the great bulk of the bananas that they have to stuff down in the effort to satisfy their hunger. The bulkiness of the food in time ruins their digestion" (p. 355). It is the belief

of leading physicians that the physical deformities following such a one-sided diet are not due to the bulk of the diet, but that they are the result of nutritional diseases which are associated with improper muscle and bone development. Some grains grown in parts of the tropics "contain twice as much starch as is advisable, and when eaten exclusively render the people liable to certain diseases such as beri-beri" (p. 355). Beri-beri is due to the lack of water-soluble B vitamine in the diet and not to an excess of starch.

7. One of the greater weaknesses of the book is to be found in its many unwarranted generalizations, not a few of which clearly are due to the fact that climatic influences occupied too great a part of the authors' horizon. In earlier days immigrants from "the cool, stimulating climates of northwestern Europe" for the most part avoided the Southern States, preferring to go to the Northern States with their energizing climate (pp. 306–307). This statement inadequately explains the fact that most immigrants settled in the North, for it ignores, among other things, their unwillingness to compete with negro labor, the fact that almost all the immigrant ships ran to the northeastern seaports, and especially the greater demand for laborers by the mines, factories, and railroads of the North. Figures 111 and 112 (pp. 346 and 347) show that the foreign trade of the United States is largely with western Europe. The accompanying text, after commenting on the desirability of increasing our trade with tropical America, reads as follows: "Yet in spite of this it is far more difficult to add a billion dollars to our trade with tropical America than to add the same sum to our trade with cyclonic Europe. The reason is largely the difference in energy. The tropical people do not exert themselves to produce goods that we want, nor do they earn enough to be able to buy large quantities of the goods that we wish to sell. Hence most of the world's trade, as well as most of its other activity, centers in the cyclonic regions." Thus climate is made to explain the situation, while the historical background, differences of race, civilization, and stage of industrial development, the sources of the colonizing peoples of the western world, and the fact that the people of western Europe and of the northeastern United States have been attempting to obtain adjustment to similar environments and so have need of various things which each readily may produce for the other—to mention only a part of the other factors involved—all are ignored. Surely this is not scholarship! In passing it may be added that the sooner American geographers and business men seriously study the environment and the needs of tropical people, with a view to offering them *what they want*, instead of dwelling upon the fact that they do not buy *what we wish to sell*, the better it will be for American trade. Discussing elsewhere (p. 256) the influence of an invigorating climate on character, Dr. Huntington declares that it is much easier to speak the truth when one feels strong than when one feels weak. One wonders how this generalization was arrived at, while at the same time he congratulates himself that he lives in a climate which is said to make for strength and truthfulness. Not all the loose generalizations result from a habit of overemphasizing the influences of climate. In seeking, for example, to emphasize how Belgium became a victim to geographical location in the war, Dr. Huntington states on page 379 that "her people suffered more than did the chief parties to the quarrel" and that her material progress was set back for decades, overlooking the fact that the devastated zone lies chiefly in France, that Belgium secured large loans from her allies and was able to restore practically all of her railways and canals in two years from the time of the Armistice, that her mills are nearly or quite on a pre-war basis in spite of the loss of machinery to Germany, that her army was so small in proportion to her total population on account of the prompt overrunning of Belgium that in spite of deportations and other sources of loss her total casualties were relatively light, and that she has priority in the German indemnity payments. As a matter of fact Belgium is being reconstructed more rapidly than either France or England.

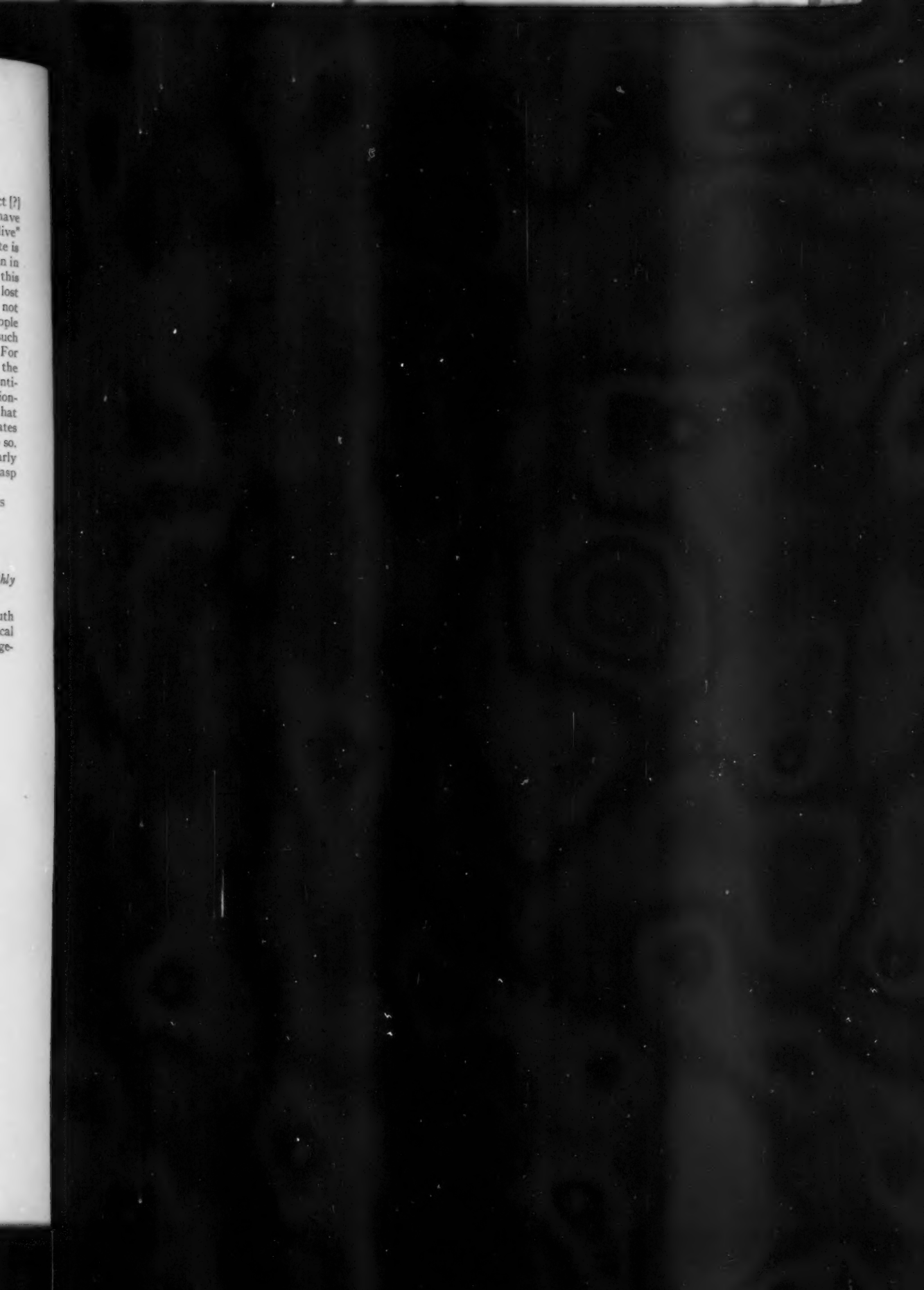
8. Numerous errors of various kinds appear to be due simply to carelessness and can be explained only by assuming that Dr. Huntington wrote much of the book in more than his usual haste. Thus we are told that Missouri is level (p. 85), that Detroit is on a lake (p. 122), that practically every river is subject to droughts and freezing (p. 134), that "the mountainous relief of Arizona causes that State to produce minerals worth more than $40,000,000 each year" (p. 167), that "in mid ocean during a storm or a battle a warship can safely [!] renew its supply of petroleum by pumping the liquid from a tender through a hose" (pp. 196–197), and that "the sun shines practically all the time in irrigated regions" (p. 325). Chile is not mentioned among the countries containing and producing much copper (p. 183), though its reserves probably exceed those of any other country except the United States and it ranked second in production in 1918; and Alaska is said to have been purchased by

the United States in part because it "is full of valuable minerals" (p. 398), though this fact [?] was not known in 1867. We are told that "some regions, . . . such as Montana, have few inhabitants because rugged mountains provide almost no place for people to live" (p. 2). Montana is an unfortunate example of the fact stated, since most of that state is not mountainous and throughout most of its history the densest population has been in its mountainous part. On page 169 one reads that "among the urban population of this country who have a small surplus for investment there are only a few [!] who have not lost money in mining ventures. They ought to know that the vast majority of mines do not pay." Presumably what Dr. Huntington meant to say is that large numbers of urban people have lost money in mining ventures. Surely it does "not pay" for scientists to make such wild statements. In not a few cases careless statements result in contradictions. For example, on page 294 Utah in its climate is said to "share many of the qualities of the Mediterranean subtropical regions," while on page 309 it is cited as an example of a "continental desert." In many cases a word of qualification would have transformed an objectionable statement into an acceptable one. Thus one cannot accept the statement (p. 289) that "in the Hawaiian Islands the absence of any duty on sugar imported into the United States has made sugar-raising the dominant industry," though of course it *helped* greatly to do so.

In view of its several good qualities it is to be hoped that the book will receive an early and thorough revision. As it stands, it is unreliable, unscientific, and displays a weak grasp of *principles*, a serious defect in a book with this title.

HARLAN H. BARROWS

SOUTH AMERICAN CLIMATOLOGICAL LITERATURE

M. M. WELCH. **Bibliography on the Climate of South America.** 42 pp. *Monthly Weather Rev. Suppl. No. 18*, U. S. Dept. of Agriculture, 1921.

This bibliography, particularly useful in view of the scattered nature of records of South America climate, gives references to data appearing in individual works and periodical literature up to January, 1919, with a few important additions of later date. The arrangement is according to countries.